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Engineering News-Record

Girders of Welded Building Tested with Hydraulic Jacks

Mississippi Problem Outlined by Chief of Engineers

Construction Control on Scattered Jobs

Welding Finds Extensive Application in Oil Field Work

Staff Report of the A.W.W.A. Convention

Typical Pipe-Line Welding in the Southwest Oil Field

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Holding Its Own

DURING the past year that great professional welfare experiment, the American Association of Engineers, has held intact its nucleus of six thousand members. It has not grown, but our report in this issue tells of a solidification and stabilization that mean perhaps more than an actual increase in enrollment. There has been a definite effort toward concentration of work on a few important and worth-while objectives, in place of a scattering of endeavor among diverse aims of less immediate value. The course of improvement has been somewhat parallel to that of the American Water Works Association, commented on in another column; but reflections on the meaning of this coincidence with respect to current events in technical society circles must remain for another occasion. The case of the A.A.E. has special appeal because it centers in the difficulties confronting the movement toward reform and regulation of the engineering profession in this late generation—with well-intrenched organizations of engineers already in existence, operating on more attractive programs. Considering the Association's history, its meteoric rise and equally rapid decline, it is fair to credit it with a definite achievement in surviving. An influential membership remains, capable of great achievement. For the present it is too much to expect large growth; the organization is doing excellently in holding its own.

Federate and Concentrate

PRUDENT hesitancy in launching a new technical society was displayed by the group of men which last week considered the need for a new "outlet" for papers on sewage research, sewage-works operation and related matters. It was fortunate that this spirit guided the conclusions reached at the Chicago conference, for there is commonly too great a readiness to create new organizations in a field already well filled. There was little unanimity beyond this point, however. No agreement could be reached as to what should be done to deal with the situation that brought about the conference, although the feeling was clear that some instrumentality is needed which does not now exist. One of the best plans offered was that a federation of existing agencies be brought about, especially state organizations like the New Jersey Sewage Works Association. Such a plan would build from below instead of from above. It would supply co-operation and correlation, and prevent overlapping of national organizations. We venture to suggest that one or another of the national bodies might arrange a conference of all existing organizations dealing with sewage-works operation, in order to bring such federation about. There were those among the Chicago conferees, too, who would be satisfied with assembly in one publication of all the papers on sewage matters. This is another view worth considering. But obviously it should be preceded by a survey and a weighing of the need for a new "outlet"—as one speaker suggested. Even if there were to be a central publication, restriction rather than increase in the outflow would be welcomed by many, to make its bulk more manageable and raise its quality. From every point of view, thus, the best present policy is to federate and concentrate.

Economic Innovations

THAT many new economic views will rise up to demand attention as soon as flood matters are placed before Congress is becoming ever plainer. One of these views is reflected in a newly organized association which aims to secure both tax relief and federal financing for drainage districts. It centers in the Mississippi Valley at present, but if successful is not likely to remain thus limited. The proposed remission of taxes would no doubt apply only to flood-visited areas, and its justification would be the emergency that renders these areas temporarily unproductive and therefore unable to pay. The plan of federal reclamation financing of drainage districts is rather different. It has the powerful precedent of arid-land reclamation to rely on, a precedent that is coupled with a long history of failure to repay the government loans and a train of evils that is still far from its end. While there is much to be said for the idea of carrying out great improvements under shelter of the low interest rates of government funds, it is hardly to the point in this connection. Unless such improvements have the unquestioned security of government investment, which alone brings about the low rate of interest, the idea is fundamentally fallacious; and this security does not characterize reclamation projects. Interesting legislative discussions may be looked for when (and if) the proposal comes up in Congress. They will be still more interesting if the Western precedent of no-interest money loaned for forty years or so is pleaded as an argument for extending the same course of mischievous philanthropy to drainage.

Snow-Line Roads

HIGHWAY relocation familiar enough in the East as a means of shortening distances and reducing grades and curves is now being undertaken elaborately in the West to avoid blockade by snow. With the growing traffic demand for year-round road service the mountain "snow line" has become a boundary to be religiously regarded by the far-western state road builder. Greatly above this level the ramparts of snow build up insurmountably while a little below it the path can be forced by moderate forces and equipment. So old roads are being changed and incidentally mileages are often being cut down and grades and curves flattened to keep the snow line above the highway. Two notable relocations that are attracting attention are the Quincy-Oroville highway in the Sierra Nevadas of

California and the Downieville-Sierra City road in Nevada. The California project, which is farthest advanced, will cut down the road elevation from a maximum of 5,900 ft. to a maximum of 3,400 ft. Except termini, every point of the new route will be lower than the old line and well below the big snows which still blockade the old road and every year keep it closed until well into the summer. The Nevada highway presents the same situation. And both projects have been initiated and are being urged upon the state highway departments by organizations of citizens of the communities served.

Service-Contracting Development

SERVICE-contractors are claiming a place of increasing importance as construction becomes more mechanized. The business is not new. The old teaming contractor was one of the species which today includes primarily the great motor-truck haulage concerns of our large cities. The bulk of the millions of yards of excavation from New York city's subways under construction is being handled by hired trucking service-contractors. Other firms are furnishing derrick-truck service. In Los Angeles a service-contractor has an $80,000 outfit of portable compressors and pneumatic tools giving 24-hour service anywhere within traveling range of his home city. So the count of service-contractors might be continued. Their function and utility deserve consideration.

The service-contractor as he is developing may not be confused with the subcontractor as the latter's function is generally comprehended. He does not ordinarily, as does the subcontractor, undertake to produce a unit of structure at a set price. He agrees merely to carry out a construction process at an agreed rate of compensation. In rendering this service he is differentiated from the workman (who also sells service), by taking on contractual obligation to give a specified volume, speed and continuity of service. Again, the service-contractor is not to be confused with the contractor who rents out equipment or even equipment with operators. He is a special type of contractor partaking a little each of the subcontractor, the workman, and the renter-out of construction equipment. What and where is his place in construction procedure and economics?

As the situation now shapes up, there are two outlets for service-contracting activities. One is the small operation where certain tasks are limited in volume but are of such nature that rather special skill and equipment are required for their performance. An example is cutting out an old concrete basement or a stretch of concrete driveway. Here the Los Angeles contractor, for example, can run in a compressor and pneumatic-breaker crew and clean up the job at decided advantage over the ordinary small builder, equipped with inferior means. Individually, operations of this kind are small, but collectively they amount to a large volume of work. The second outlet is the large operation where there has to be a heavy concentration for a short time of equipcent service which may not be at all required during the remaining longer period of construction. An example is basement excavation haulage in tall city building construction. Hauling, traveling-crane work, small power-shovel work, trench excavation, trench backfilling, concrete mixing, portable compressor and pneumatic tool work, all come within the category of operations open to service-contractors. All, indeed, have here and there been handled by service-contractors.

Except the motor trucking contractors, these service-contracting concerns have been comparatively small and of distinctly local activity. This condition is rapidly changing. A firm operating mobile compressors and pneumatic tools aggregating $80,000 in value is of reputable magnitude even in these days of large contractors' plant investment. The development of increasingly mobile equipment is largely accountable for the change. There have been broader influences—as increasing specialization in construction—but the highly mobile equipment unit, even of the bulky kinds like power shovels and cranes, is the principal responsible motive. When, as is now the fact, a crane outfit capable of half a dozen changes of use can be moved from job to job at motor-truck speeds, and on the job by modern high-speed crawler traction is given mobility and coverage not much less speedy and complete than a shovel crew and cart, we have to revise entirely the traditional conception of large construction equipment as only ponderously portable. It is, on the contrary, highly mobile in many of its units. And that this mobility of equipment extends the horizon of contracting is excellently emphasized by the development of service-contracting.

Water-Works Association Progressing

TEN years ago the most that an impartial observer could say of the American Water Works Association was that it was growing rapidly in numbers but was loose-jointed and rather aimless in its work. No one could tell whether it would continue that way or take its place with the other national technical associations. Its lack was not competent men but their effective utilization. A large part of the membership objected to domination of the society by the technically-trained men, and there was difficulty in getting the most capable ones to take much part in the organization's work. These conditions have undergone a profound change in the decade just past.

The standardization council revolutionized the association. It found work for all classes of members and got them to do it through a large number of committees. It chose, directed, and correlated the committee work, saw that voluminous data and lengthy reports were condensed and made readily usable by all the members, and assembled the result in the now well-known Manual of Water Works Practice. Inasmuch as such material soon gets out of date, a large committee on revision has been formed, and will soon be busily at work—only two years after publication of the manual. A relative lull in committee activity has now taken place, but, far from a cessation of such work, concentration is in view. The committee on Boiler Feedwater Studies illustrated the magnitude of its field by holding two lengthy sessions at Chicago last week. Through co-operation with other organizations it enlists strong support from railways, municipal utility companies and various manufacturers. Opportunities for the steel pipe line committee differ only in kind and magnitude. These two committees could wisely use $100,000 on their studies within the next few years.

In some respects the most promising development in the association is the creation of a committee on water-works administration. Here there is immense

opportunity for useful work. Much of it will be study of technical and financial administration, but the larger need is along civic and (in the best sense of the word) political lines. This committee will doubtless bring to the membership and the work of the association a class of men not well represented heretofore—department heads and members of commissions, a group quite separate from the engineers, chemists and superintendents.

One of the wisest accomplishments of the Chicago convention was to sidetrack the rather surprising movement to form a sewage-works section, the strongest advocates of which tended toward making it a sewage and water-works association. The association has much yet to do before it can claim to cover the water-works field alone, both in membership and activities. Its strength lies in cultivating the interests of water-works solely, and the best promise for the future is found in the fact that this truth is recognized by the leading members of the association.

Short Lines Still a Problem

RECOMMENDATIONS made to the Interstate Commerce Commission by its examiner on the New York Central Railroad's application to lease certain of its subsidiary lines are both unreasonable and unfair to the company. He recommends that the commission reject the application of the New York Central for permission to lease some of the lines which it already controls through stock ownership, including the Michigan Central and the Big Four, because the proposed leases make no provision for the short lines which connect with these railroads. Thus one railroad would be forced to absorb the neighboring short lines before any fixed policy has been established under which all railroad systems must absorb the short lines in their territory.

Leasing of these lines is little more than a bookkeeping operation in so far as railroad consolidation is concerned. The New York Central owns a large majority of their stock, and already operates them as part of the New York Central Lines. But in so far as the rights of minority stockholders are concerned, the leasing has possibilities of injustice which need to be looked into closely by the commission; for, as noted in the case of the Ford Lines lease, it is possible for the leasing company, when it owns most of the stock, to make a lease which will be very unfair to the minority stockholders. The majority stockholders get their profit through the lease to themselves rather than through the return on their stock in the leased company. Consequently, the commission would be fully justified in rejecting the New York Central leases on the grounds that the minority stockholders' rights are not fully protected. But the commission has no such clear-cut case when it comes to rejecting the leases on the grounds that the short lines are not to be taken into the New York Central system at the same time.

Congress, when it wrote the railroad consolidation law, indicated that it desired to have the short lines included in the large railroad systems into which it proposed that the existing railroad lines be grouped. They were to be assigned to the various systems in a general plan to be prepared by the commission. No such plan has been forthcoming, except in a tentative form, and as the years pass it becomes more evident that the practical difficulties in the way of preparing such a plan are insurmountable. In view of this, for the commission to say to the directors of the New York Central that they cannot consummate these leases unless they make some provision for absorbing the short lines in their territory, while a competing system such as the Pennsylvania is not at the same time compelled to absorb the short lines in its territory, is manifestly unfair to the New York Central. In most cases the absorption of the short lines will be a burden to the larger systems, and it is not an equitable procedure to force one major system to burden itself with short lines unless other systems are to be similarly treated.

The problem of the disposition of the short-line railroads is a knotty one. It will not be helped by any such hasty action as this of dragging it into a situation where it properly does not belong. The commission is not being called upon to decide whether these lines belong in the New York Central system in a general consolidation plan, but as to whether the lease of lines which it already controls through stock ownership is proper. If it decides that question in such a way as to protect the minority stockholders, it will have done its duty. The question of short line absorption should wait until a definite national policy has been determined upon.

Interstate Motor Carriers Must Pay

EVER since interstate motor vehicle haulage for hire attained significant magnitude there has been contest between state highway regulatory agencies and the vehicle operators conducting this kind of transportation. Lacking congressional action to regulate interstate motor transportation, the states, to avert a breakdown of their regulatory system, have from the first gone as far as possible to extend their jurisdiction. They undertook to deny to interstate motor carriers, where they deemed it for the public good, certificates of public convenience and necessity. A check was received on the first action taken by the motor carriers to the U. S. Supreme Court, which decided in several cases having different legal phases that denial of certificates by states to interstate carriers was violation of the commerce clause of the constitution.

Good lawyers held that despite these decisions regulation was still open to the states in respect to various features of administration and operation: imposing taxes, limiting speed of travel and number of passengers, and other matters affecting public convenience and security. Equally good lawyers held contrary opinion. Obviously here was a situation which would see battle joined as soon as an interstate carrier came along who was willing to try issue. Such a one was found in the firm of Clark & Riggs operating as common carriers across the Indiana-Ohio line. A statement of the case and the decision handed down are given in the news pages of this issue. Briefly told, the decision affirms the right of states to impose taxes on interstate motor carriers and to regulate their operation to insure safety and conservation of the highways.

This ruling touches vitally certain states across which are hauled loads originating in one state and destined for a third. They can demand rightful pay for the road service they render to a business from which they benefit in no other way. Highway officials have reason to feel gratified for so clear-cut a determination of a troublesome problem in highway traffic regulation.

One of a Series of Articles on
OIL FIELD ENGINEERING

Welding Finds Extensive Application in All Oil Field Work

Available Scrap Pipe Provides Suitable Material for Welded Buildings, Tank Equipment, Fences and Stairways—Welded Pipe Lines Increasing in Favor

WELDING, both arc and oxyacetylene, finds one of its most extensive uses in oil field work. The degree of its acceptance by the different companies varies but that it is growing in favor cannot be denied. Pipe line companies are probably the largest users, but drilling operations, gasoline plant construction, the building of compressor plants, and transportation facilities provide an extensive field for the application of welding.

The structural work is largely done with pipe sections. The large supplies of scrap pipe which accumulate provide excellent material for the types of structures that are needed. Almost all of the oil companies have developed skilled welding operators and the large amount of welding work available has also attracted other welding operators so that the labor supply is not a problem.

FIG. 1—A WELDED FRAME GAS METER HOUSE

Arc welding is used most extensively on roof construction of oil storage tanks. Pipe line work is done by oxyacetylene welding as is most of the structural work using scrap pipe. The welding torch has not only provided an outlet for otherwise useless material, but by providing work has kept the welding organization busy during slack seasons and at the same time has saved the oil companies large amounts of money and considerable time.

FIG. 2—SHORT PIECES OF PIPE RECONDITIONED AND WELDED INTO 40-FT. LENGTHS
The building is also of welded construction.

The accompanying illustrations give an idea of some of the various types of structures fabricated in the oil field by welding. The Oklahoma Natural Gas Co. has developed a welded frame meter house finished with wire mesh and stucco that is adaptable to use in residential sections of a city. A welded fence adds to the attractiveness of the layout. The same company has instituted a policy of reclaiming short lengths of pipe, shipping them to the shop and welding into 40-ft. lengths for future use. Both the Carter Oil Co. and the Phillips Petroleum Co. are using welded fences along the streets of their large operating and construction camps. The former company has developed a welded pipe tower for elevating its water tank for camp supply.

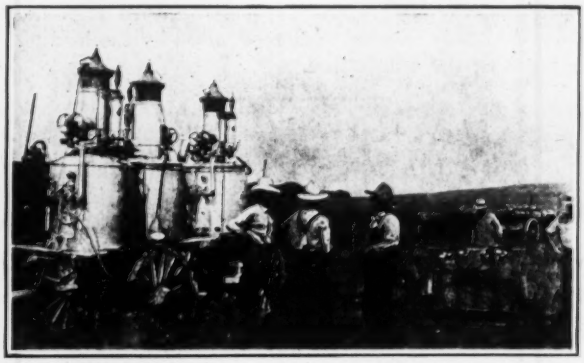


FIG. 3—TYPICAL OXYACETYLENE WELDING OUTFIT USED ON PIPE LINE WORK

Boiler repairs are almost exclusively made by welding. Pipe not too badly pitted is also repaired in the

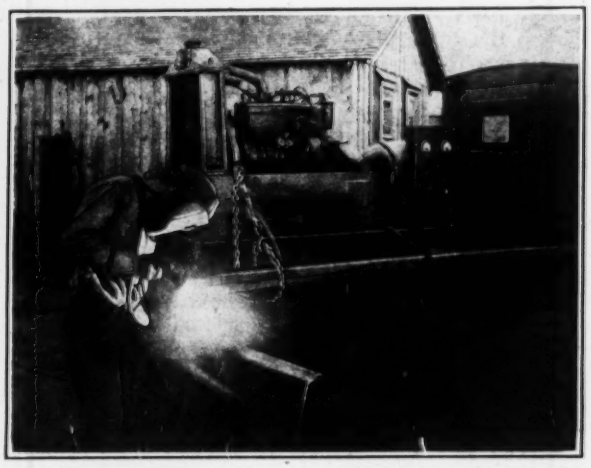
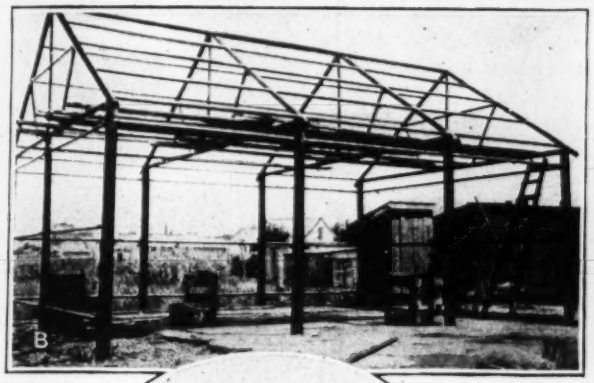
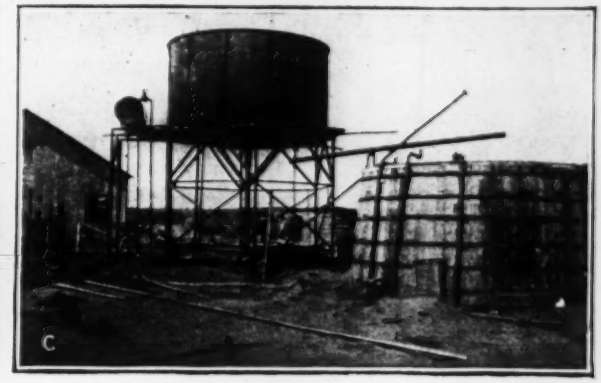


FIG. 4—ARC WELDING OUTFIT MOUNTED ON TRUCK FOR MOBILITY





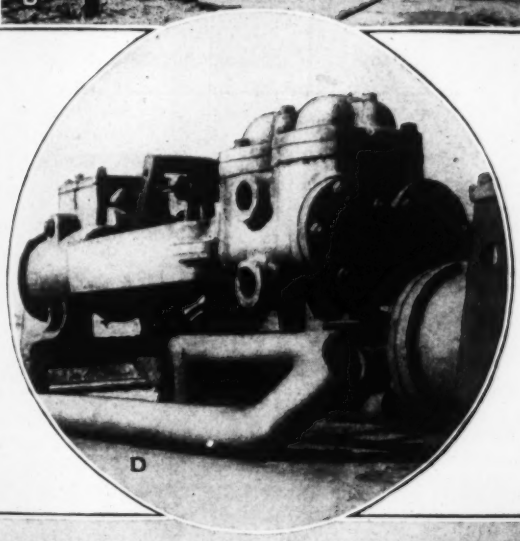
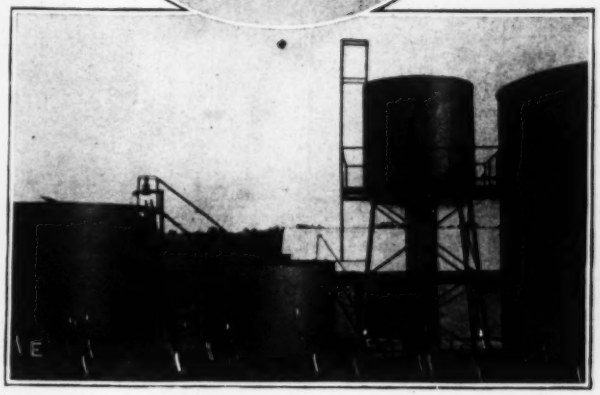
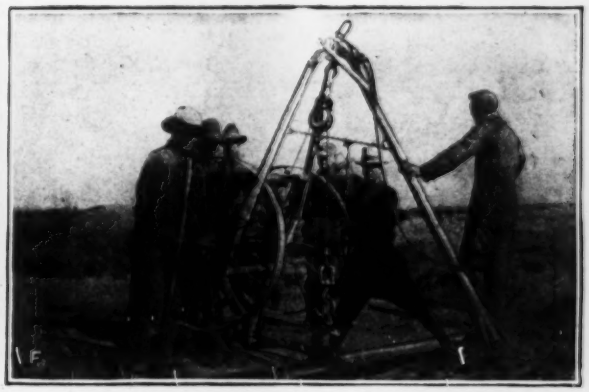


FIG. 5—VARIOUS EXAMPLES OF OIL FIELD WELDING WORK

A—Welding a large gas pipe line.
B—Welded pipe framework for garage.
C—Welded water tank tower.
D—Mud sled and steam pump base of welded pipe.
E—Welded pipe tower and welded tanks.
F—A welded pipe line hoist.





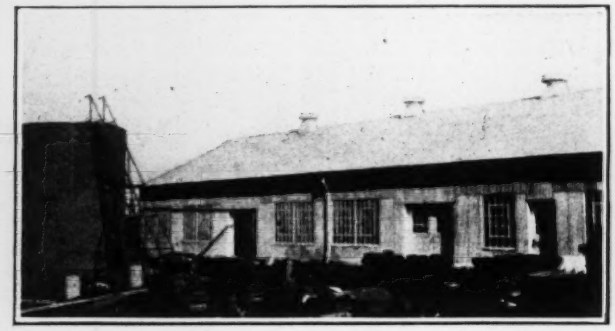


FIG. 6—WELDED PIPE FRAME BUILDINGS

View at left shows completed Caney shop building. This is shown also in Fig. 7. Note also the welded tank and the welded stairs.

Right-hand view shows welded pipe frame pumping station. Note also welded fence around valves and the welded stair bridge over the firewall in foreground.

same way. Storage tanks whose bottoms have rusted through are repaired by welding instead of cutting the tank down, laying a new bottom and re-erecting the shell. Mud sleds for transporting equipment in the field are commonly made of welded pipe. Another use for welded work is in fabricating stairways for tanks and footbridges over small ditches; steps and walkways of old tank plates with pipe framework and hand rails are the materials used. Pipe fittings for heavy duty are often made up of welded pipe sections. The complicated pipe layouts at intake and discharge manifolds of pipe line pumping stations in many cases have been simplified by welding.

The practice of welding large pipe lines is growing very rapidly. The Prairie Pipe Line Co., the largest of the pipe line companies in whose system there are 12,000 miles of pipe is the pioneer in welding high pressure oil lines. Its first welded line was started in December, 1920, as an experiment. Today the company installs nothing on its trunk lines but welded pipe. Others of the large pipe line companies, among them Sinclair, Magnolia and Gulf, have substantial mileages of welded lines. Characteristics of such oil pipe line work are the heavy ripple welds used, the constant effort made to eliminate all overhead welding, and the special care used to keep "icicles" from forming inside the pipe.

First adopted as a measure to keep the welding organization intact during slack seasons and now operated as an important part of the Prairie Pipe Line Co.'s activities, utilization of scrap pipe has expanded rapidly. Pump station buildings, garages, and a large repair shop have been fabricated by oxyacetylene welding. All buildings are made portable and complete design and plans are prepared in the engineering office. Such buildings are probably not any cheaper than purchased buildings except for the fact that the scrap pipe is al-

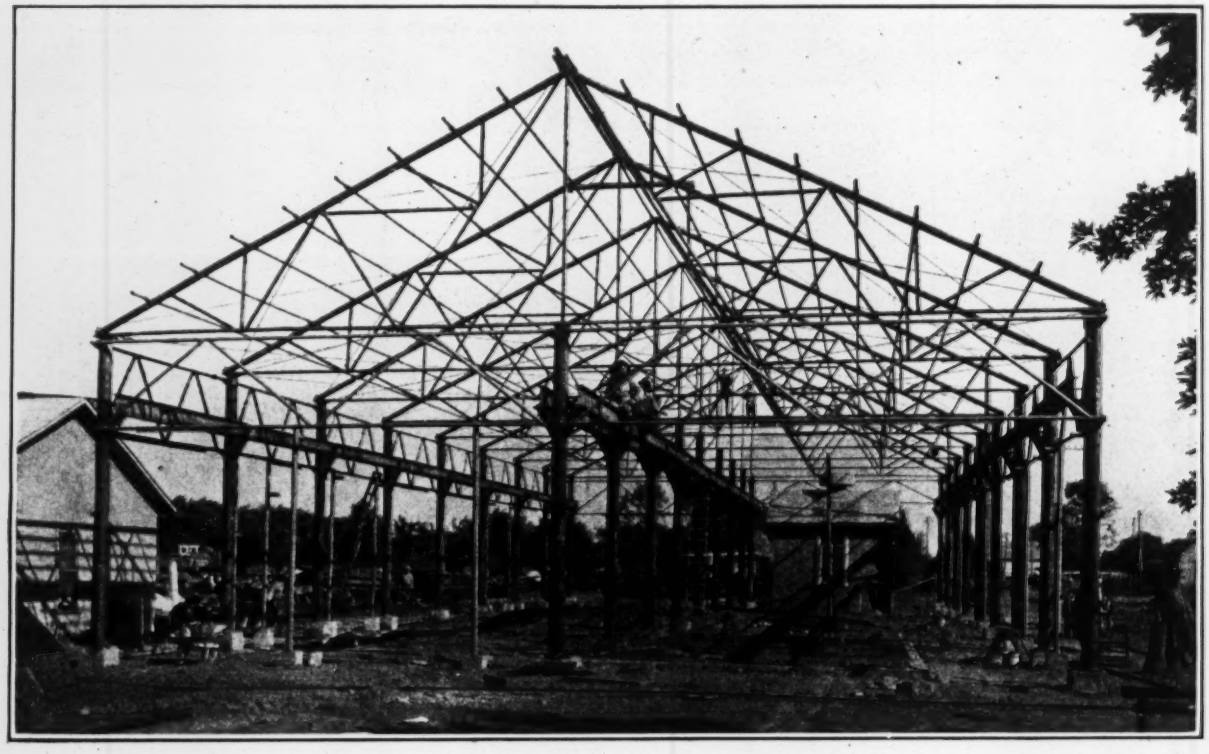


FIG. 7—WELDED PIPE FRAMEWORK FOR 50x120-FT. BUILDING

Bolted connections are used for unit portability; I-beam runways provide for two 4-ton traveling cranes.

ready on hand. Tank towers, stairways, small footbridges, mud sleds and similar structures are fabricated at the company's main shop and supplied to the various points in the field as needed. There is, of course, considerable welding fabrication done in the field when necessary.

The largest welded pipe frame building which the company has constructed is being used as one of the main buildings at its Caney, Kan., shops. The building is 50 x 120 ft. in plan and 30 ft. high consisting of 8-in. pipe columns, 2-in. pipe roof trusses, and 2-in. longitudinal truss girts. This building was illustrated in *Engineering News-Record*, Nov. 27, 1924, p. 878. Two-inch straight pipe purlins were used on this building but trussed purlins have been adopted on more recent structures as being more substantial; pipe strength is developed very well when used as a column

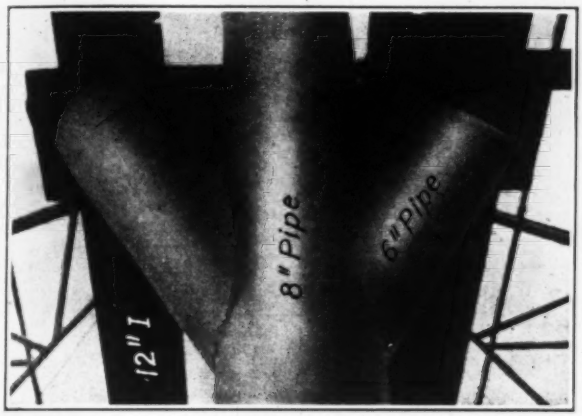


FIG. 8—DETAIL OF WELDED BRACKETS FOR CRANE RUNWAY

and as a component part of a truss, but rather poorly when used as a beam. All joints are assumed to develop the full strength of the pipe which is taken as 12,000 lb. per sq.in. The minimum size of pipe used is 2 in. in diameter. This building, as well as the other welded buildings which the company has erected, is designed for portability by units. The purlins are bolted to the trusses by means of clip angles welded to the top chord of the truss; the trusses are bolted to the column caps, and the side truss girts are bolted to angles welded to the column, as are the other side frames. The crane runway brackets are of 6-in. pipe and support a 12-in. 31-lb. I-beam track for a 4-ton traveling crane. Twenty-gage corrugated iron walls and roofs are used on the buildings, held in place by aluminum wire nails.

Motor Equipment for Road Maintenance

Approximately 43 per cent of the Wisconsin state trunk highway mileage will be maintained this year by motorized equipment, according to a report of H. J. Kuelling, state highway engineer. It is stated that the advantage of this type of equipment lies in the ability to cover a greater mileage of road in a given time, while in most cases heavier work can be done than with team patrols. Motor patrols are in many cases supplemented by teams, because some of the work cannot be done by motor equipment.

Fatigue Resistance of Welds

ENDURANCE tests of welded joints carried out during the past year by the Army Air Service at McCook Field, Dayton, Ohio, and reported by R. R. Moore before the American Welding Society in April, showed variable and in many cases low fatigue strength. The test results are summarized in the table below. Most of the specimens were ½-in. and 1-in. tubes with a butt-welded joint at the middle of the test length. They were tested in a rotating-beam machine, the specimens ranging from 3½ to 14 in. long. Various types of electrode rod and three welding methods were included in the tests.

In general, the three test methods—gas welding, arc welding, and atomic-hydrogen welding—gave results of the same order. In all cases the test specimens showed a definite endurance limit, the number of cycles required for failure increasing as the stress on the test piece was decreased, and finally reaching a point at which the load appeared to be sustained indefinitely. This endurance limit is distinctly lower than that of the metal itself. Static tensile strength tests gave values varying from 50,000 to more than 60,000 lb. per sq.in., but the endurance limit was in one or two instances as low as 8,000 and 9,000 lb. per sq.in. and the maximum endurance limit obtained was 22,000 lb. The values ranged for the most part

ENDURANCE TESTS OF WELDED JOINTS

Type of Welding	Tensile Strength, Lb. per Sq.In.	Endurance Limit, Lb. per Sq.In.	Endurance Ratio Lb. per Sq.In.
Gas Welding			
Norway iron wire	60,300	13,000	0.215
Low carbon wire	56,500	16,000	0.283
Vanadium wire	57,500	14,000	0.243
Chrome-molybdenum	59,400	8,000	0.134
Norway iron wire	62,400	22,000	0.353
Norway iron wire—"cleaned up"	53,500	17,000	0.318
Norway iron wire deposited	50,500	24,000	0.475
Arc Welding			
Steel Kote wire—1 in. dia. tubes	60,800	14,000	0.230
Steel Kote wire—½ in. dia. tubes	66,600	16,000	0.240
Steel Kote wire—"cleaned up"	47,720	9,000	0.189
Deposited weld	62,500	24,000	0.384
Atomic Hydrogen Welding			
Filler rod same as tube	50,400	16,000	0.317
Filler rod same as tube—"cleaned up"	56,650	18,000	0.318
Deposited filler rod	45,860	17,000	0.371
Cast Steel	78,550	32,000	0.408

between 13,000 and 18,000 lb. per sq.in. In comparison, specimens made up solid from deposited electrode metal showed a higher endurance strength than the welded tubes, which indicates that the low endurance strength of the welds cannot be explained on the assumption of inherently defective character of the weld metal. The endurance ratio (ratio of endurance limit to ultimate tensile strength) varied between 0.13 and 0.35. A specimen of cast steel, on the other hand, showed an endurance ratio of 0.41.

Several long-time tests on welded joints are still running. The author reported that two specimens at a stress of 24,000 lb. per sq.in. have completed over 600,000,000 and 700,000,000 cycles without failing, and another at 23,000 has completed 700,000,000 cycles.

From examination of the welded joints after fracture it is concluded that poor fusion has marked effect on the endurance of a weld, so that a fatigue test may detect poor fusion where a static tension test does not.

New Sewage-Works Being Built for Oklahoma City

Two Interceptors Each Leading to Imhoff Tanks with Provision for Sprinkling Filters—Capacities and Costs

BY SAMUEL A. GREELEY
Pearse, Greeley & Hansen, Consulting Engineers, Chicago, Ill.

TWO sewage treatment plants and intercepting sewers, to serve the north and south sides of the city independently, are now under construction at Oklahoma City, Okla., to abate the pollution of the North Canadian River and Deep Fork Creek. In 1919, B. M. Hart, city engineer, with the advice of a citizens' committee and the approval of the City Commission, retained Pearse, Greeley & Hansen, of Chicago, as engineers to report on projects for abatement of the stream pollution. The recommended projects comprise north and south side intercepting sewers and sewage-works consisting of Imhoff tanks and sprinkling filters. Bonds in the amount of $950,000, sufficient to build the intercepting sewers and settling tanks, were voted in December, 1925. Plans were finished in the spring of 1926 and the work is now nearing completion. Most of the existing sewers are on the separate plan. The capacities of the various structures are briefly summarized as follows:

Item	North Side	South Side
Population for		
Intercepting sewers	87,000	235,000
Treatment works	29,000	136,000
Sewage quantities, gal., per capita, average		
Intercepting sewers	150	255
Treatment works	50	100
Settling period, hr.	3.0	2.0
Sludge capacity, cu.ft. per capita	1.75	3.16
Chlorination contact time, min.	30.0	30.0
Sludge beds, sq.ft. per cap.	0.5	0.5
Length of intercepting sewer, ft.	12 114	16 700

The north side sewage is largely domestic, with an average suspended matter of 224 p.p.m. The south side sewage contains packing house waste and has an average suspended matter of 300 p.p.m. The packing houses have agreed to install adequate clarification devices at their plants. The collection sewers are largely sanitary, but there is some storm sewage.

The south side intercepting sewer is of monolithic concrete. The treatment plant comprises a grit and grease basin, a Venturi meter, Imhoff tanks, open sludge beds, chlorinating plant, flood dike and appurtenances. The north side intercepting sewer is largely of precast reinforced-concrete pipe and the treatment plant is similar to that on the south side. In both cases provision has been made for adding works for complete treatment, now projected as sprinkling filters. Tentative plans have been made at the south side plant for a small testing station to try out contact aeration, pre-aeration and sprinkling filters. The contract amounts for the several divisions of the work are:

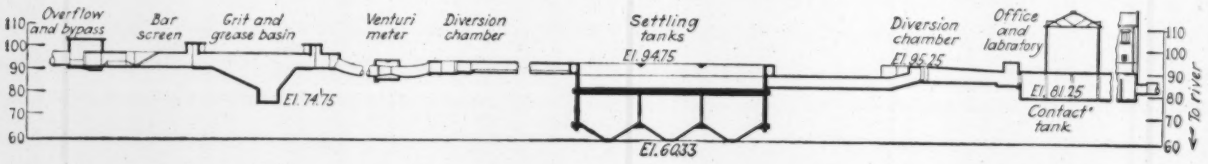
Division	Total	
South interceptor	$160,561.56	
South treatment plant	478,605.20	$639,116.76
North interceptor	$146,721.60	
North treatment plant	86,548.00	233,269.60
Grand total		$872,436.36

The per capita cost of the south side plant is thus $3.50 and of the north side plant $3, both exclusive of intercepting sewers. Concrete in Imhoff tanks (1:2:4) was bid in at $26.25 per cu.yd. for the south works and $24.50 for the north works. The bid prices per lineal foot on several sizes of sewers were: 30-in., $4.50; 36-in., $5.85; 39-in., $6.30; 60-in., $12.06; 66-in., $12.51, and 72-in., $14.03.

The general arrangement of the south side treatment plant is shown by the accompanying profile. Ground water stands at about El. 88. Owing to the possibility of a considerable upward pressure from ground water outside the tanks, bronze relief valves were placed in the bottom of each hopper, as shown.

The work was handled through the Department of Public Works, of which Warren E. Moore was commissioner, and under the general direction of B. M. Hart, city engineer, with Pearse, Greeley & Hansen, of Chicago, as consulting engineers.

[*Details of construction will be given in an ensuing article.*—EDITOR.]



PROFILE SHOWING LINE OF FLOW THROUGH OKLAHOMA SEWAGE-WORKS

Drainage Provisions in Gibson Dam

In the design of the Gibson dam, on the north fork of Sun River, 80 miles west of Great Falls, Mont., the Bureau of Reclamation has made very full provision for relief of possible uplift pressure in the dam and its foundation. Three-inch vertical concrete drains 3 ft. from the upstream face of the dam, and 4-in. drain pipes in the upstream cutoff connecting with drainage holes drilled in the foundation, will drain to 6-in. horizontal pipes leading to the downstream side of the dam. The drainage pipes are spaced 5 ft. apart along the dam. Upstream of each drain is a grout pipe, the grout holes to be drilled after the upstream cutoff has been excavated; when the foundation had been grouted, the drainage holes are to be drilled into the rock through the 4-in. drainage pipes. Construction of the dam has been in progress since last December. The structure will be 195 ft. high and 900 ft. long and will create a reservoir of 90,000 acre-ft. capacity, capable of being increased to 105,000 by drum gates on the spillway, later to be installed if needed. The spillway, located in the north abutment, will have a discharge capacity of 50,000 sec.-ft. over an uncontrolled circular lip discharging by a vertical shaft into a horizontal tunnel leading to the lower level.

A Method of Construction Control of Scattered Jobs

Forms and Reports for Supervising and Controlling a Large Number of Widely Scattered Jobs of Various Kinds and Sizes

By M. R. Sumner
Construction Engineer, Duquesne Light Co., Pittsburgh, Pa.

THE engineering department of the Duquesne Light Co. is organized, under M. R. Scharff as chief engineer, to handle a large volume of engineering design and construction for the company and some of the work for several other affiliated operating companies in the Pittsburgh district. The Duquesne Light Co.'s generated output of electric energy was 315,000,000 kw.-hr. in 1914, and in 1925 the total output was 1,228,000,000 kw.-hr., an increase of almost 400 per cent. Growth in load means expansion of facilities.

Engineering Organization—Under the chief engineer there are several divisions: Planning; design; production; civil; construction; and valuation. The construction division, with which we are particularly dealing, is organized as follows:

Construction Engineering
- Building and underground
- Electrical
- Mechanical
- Contracts
- Office

Kinds of Work Handled—The work handled covers system and customer's high-tension substations; underground electric conduit structures; buildings; steel towers; steel and concrete railway bridges; steam heating system extensions; river dredging and river equipment, such as coal unloading towers and steel coal barges; coal mine improvements; submarine electric cable crossings under rivers; office buildings; appliance stores; electric system betterments, additions and improvements. The system area over which the work is extended covers something over 1,000 square miles in Allegheny, Beaver and Washington counties, its center being Pittsburgh.

The work supervised and completed by the construction division in 1925 was valued at approximately $2,750,000. Its supervision is chiefly of interest because it consisted of so many individual, relatively small,

SUMMARY OF WEEKLY REPORT
CIVIL, UNDERGROUND & MECHANICAL SECTION
CONTRACT SECTION
ELECTRICAL SECTION

During the week ending October 16, 1926, 25 jobs were issued, of which are:

STATUS	CONTRACT SECTION	CIVIL, U.G. & MECH. SECTION	ELECTRICAL SECT.
Completed	0	0	0
Active	3	1	0
Not yet started	1	9	11
Total	4	10	11

Statement as to condition of all jobs being handled by the above three sections in addition to and inclusive of those mentioned above:

STATUS	CONTRACT SECTION	CIVIL, U.G. & MECH. SECTION	ELECTRICAL SECT.
Completed	5	2	7
Active	32	21	66
Not yet started	7	15	38
Total	44	38	101

Total No. Jobs in all sections 183

J. W. Lambert

FIG. 2—SAMPLE WEEKLY SUMMARY OF PROGRESS

ORIGINAL

FORM ENG. 128-3M SETS. 10-25

LOCATION Penn Avenue, Pgh., Pa.

CONST. DIVISION: WORK ORDER: No. CS 835

DATE ISSUED 7/6/26 CHARGE 6804-D ACCT 261 ISSUED TO B. Wray

REQUESTED BY M.R.Sumner OF Construction BY Contract ON 7/5/26

SCHEDULED START 7/10/26 ACTUAL START 7/11/26 SCHEDULED FINISH 8/30/26 ACTUAL FINISH 8/27/26

DESCRIPTION OF WORK

Follow the construction of a 10-way duct line on Penn Avenue Between 7th & 8th by J. Toner Barr Co.

PLAY SAFE

GIVE ALL INFORMATION REQUESTED AND BE PROMPT TO NOTIFY CITY OFFICE OF STARTING AND COMPLETION DATES

REMARKS

The above work must be done at night due to traffic conditions existing in this section of Penn Avenue during the day.

APPROVED BY M. R. SUMNER	STARTED BY J. TONER BARR	COMPLETED BY J. TONER BARR
DATE 7/6/26	DATE 7/11/26	DATE 8/27/26
INSPECTED BY P. C. SMITH	COMPLETION NOTICE SENT J. W. LAMBERT	TOTAL COST OF JOB $4200.00
DATE 8/30/26	DATE 9/20/26	OVER EXPENDED / UNDER EXPENDED $ 50.00

ORIGINAL TO FOREMAN. RETURN WHEN JOB COMPLETE. DUPLICATE TO TIMEKEEPER. TRIPLICATE RETAINED

FIG. 1—WORK ORDER ISSUED FOR EVERY CONSTRUCTION JOB

WEEKLY REPORT— ELECTRICAL SECTION
JOBS STARTED BUT NOT COMPLETED— WEEK ENDING OCTOBER 16, 1926.

W.O. No.	W.O. Issued	Charge	Description of Work	Date Started	Per Cent Last Week	Per Cent This Week	Remarks	Assigned
174	6/17	6164-D	Verona S.S.Remove 3ϕ power circuit	7/28	80	80	Awaiting OH line plans	Graffius
240	8/6	6255-D	13th St. Stanwix transmission line	8/11	95	98	In progress	Walton
233	8/2	6097-D	48th St. Sub. Syn. Cond. Protection	8/16	60	60	Awaiting Carbon breaker	Willard
255	8/4	6258-D	E.E.Substation Neutral Ground	8/6	20	30	In progress	Graffius

FIG. 3—PORTION OF WEEKLY DETAIL PROGRESS REPORT

jobs which were carried on simultaneously over the considerable area indicated above. Recent progress reports indicate over 100 jobs in various progress stages.

Control System—The control of this work is assisted by a work order system developed to suit the particular requirements. When a project is formally authorized by a construction order together with plans and specifications, it is issued to the proper section of the construction division accompanied by a letter of instructions and a work order, the face of which is shown by Fig. 1.

The work order number is placed in the upper right-hand corner on the face of the form. Reference to the form will indicate quite clearly the nature of the other information which is filled in by the work dispatcher who issues these orders. It may be noted that the reverse side of the form is ruled to record progress from week to week. The original form is issued to the superintendent who is to do the work; the duplicate is forwarded to the chief timekeeper who uses it for checking the accuracy of time charged for labor; and the triplicate is retained by the work dispatcher for his file and for his preparation of weekly and semi-monthly reports on progress.

The work order system insures that the issuance of all new jobs shall be through one channel, as no work is permitted to be done unless authorized by a work order. It gives the chief timekeeper a means of checking labor charges; and by means of it the work dispatcher calls on all section heads, or their representatives, for a weekly or semi-monthly report as to the status of every project being handled by the construction division. With these data he prepares his report and charts for the information of the chief engineer and the construction engineer.

A typical summary sheet of a weekly progress report is illustrated by Fig. 2. The complete report shows briefly the status of every job being handled. A portion of a typical page is shown in Fig. 3.

A semi-monthly report is made by the electrical section because of the large number of jobs always in progress; the delays due to outages required; the work to be done by customers. Fig. 4 shows a typical sheet.

Semi-monthly report
Electrical Section - Construction Division
Period October 1 to 15, 1926 Incl.

THIS REPORT IS DIVIDED INTO FIVE SECTIONS, AS FOLLOWS:

A - CONSTRUCTION ORDERS RECEIVED - - - - - - - - - - - - - - - - 10

B - CONSTRUCTION ORDERS PREVIOUSLY RECEIVED, NOT YET COMPLETED - 45

C - CONSTRUCTION ORDERS COMPLETED AND CLOSING LETTERS SENT - - - 11

D - CONSTRUCTION ORDERS HELD UP AND REASON THEREFOR- - - - - - - 7

E - FINANCIAL STATUS OF CONSTRUCTION ORDERS- - - - - - - - - - - 39

SIGNED:

R.B.Brissenden

APPROVED: L.

Construction Engineer

Cc to Messrs.F.R.Phillips, E.A.Murray, F.N.Pickling.

FIG. 4—SUMMARY SHEET OF SPECIAL ELECTRICAL SECTION REPORT

SECTION E-- ESTIMATED FINANCIAL STATUS OF CONSTRUCTION ORDERS ASSIGNED TO THIS SECTION

C.O.No.	Name of Station	Total Author. our portion	Expended to date	Est. Amount to complete	Indicated overrun	Indicated underrun
5580-D	13th St. Substation----------	57,280.	55,432.	1848.	------	------
5599-D	Ambridge-J. & L. ----------	940.	961.	90.	111	------
5756-D	Kennywood Substation---------	16,690.	15,562.	1128.	------	------
5832-D	Lawrence Substation----------	10,990.	7,833.	3157.	------	------
5847-D	Colfax Power Station---------	127,360.	117,455.	9905.	------	------
5894-D	East End Substation----------	14,280.	13,858.	422.	------	------
6055-D	Ambridge Substation----------	132,770.	88,554.	44216.	------	------
6064-D	Crucible Steel Co. ----------	7,510.	1,292.	6218.	------	------
6097-D	48th St. Substation----------	2,110.	1,540.	570.	------	------
6147-D	13th St. Substation ----------	3,000.	4,900.	60.	1,660 *2	------
6208-D	Brunot Island Power Sta.-----	7,800.	544.	7256.	------	------
6229-D	South Hills Substation-------	12,810.	10,749.	2061.	------	------
6236-D	North Substation------------	32,300.	2,423.	29777.	------	------
6289-D	Standard Seamless Tube Co.---	1,270.	399.	871.	------	------
6299-D	Economy Substation----------	45,130.	19,790.	25340.	------	------
6332-D	Hardy & Hayes ----------	6,840.	5,495.	1345.	------	------
6333-D	McCreery & Co. ----------	6,540.	3,815.	2825.	------	------

FIG. 5—SAMPLE FINANCIAL STATUS REPORT OF CONSTRUCTION OPERATIONS

The most important part of this report, for purposes of financial control, is Section E. Some typical items from a recent report are shown by Fig. 5. This part of the report gives, at a glance, the status of the expenditures on each project in active progress.

The improvement program in general is guided by job schedules and load charts prepared by the production division of the engineering department. Load control charts, based on the estimated man-hours of work on hand, and the available man-hours of labor on the payrolls, have proven to be helpful as a means of keeping informed about the volume of assigned construction work compared with the available forces of mechanics and laborers. These charts are plotted each week for the underground force, the electrical force, and the civil, or building, force. Note sample in Fig. 6.

As a means of keeping a convenient record of the location of various crews of mechanics from week to week, a weekly crew line-up report is made by the electrical section and by the building, underground, and mechanical sections, Fig. 7.

The practical value of these charts is considerable; they show at a glance the degree to which the crews are loaded with work; they show whether or not new jobs can be handled efficiently with a minimum of interruptions to other jobs; and they absolutely answer the question: "How much work has that particular section on hand at the present time?" The charts have been

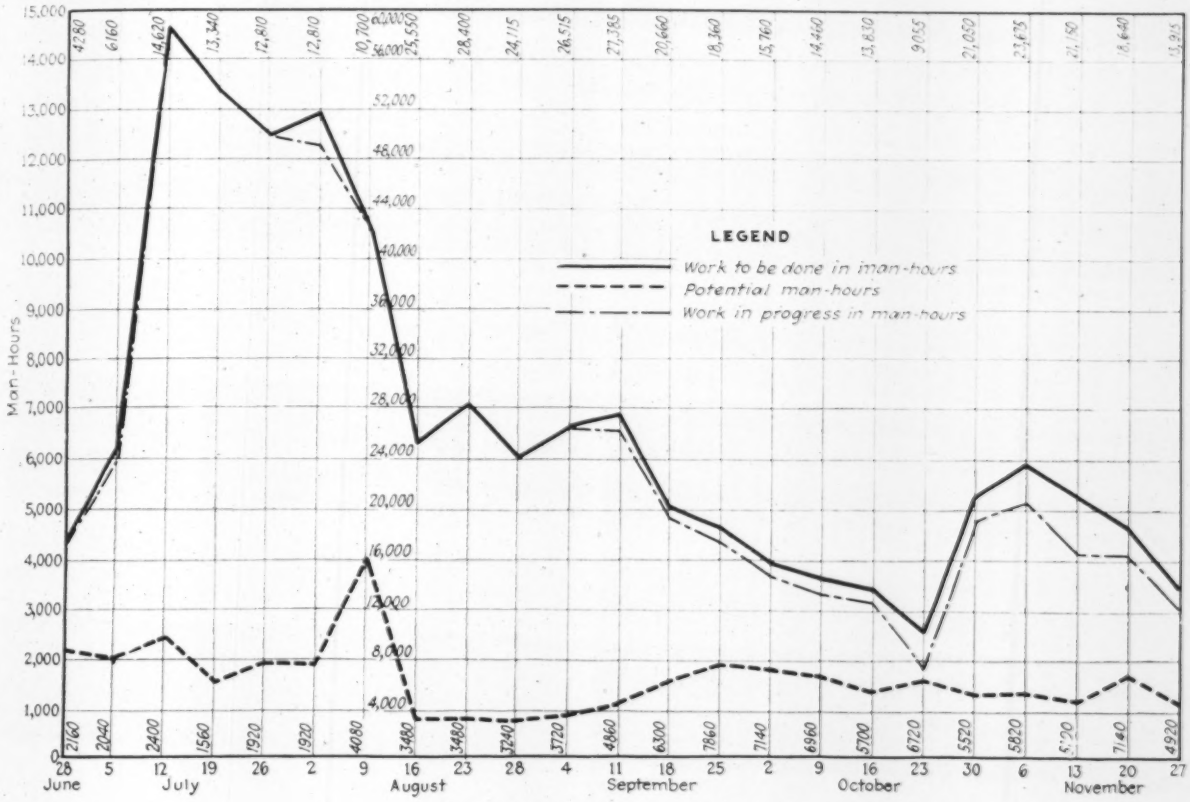


FIG. 6—LABOR LOAD CONTROL CHART

particularly helpful in determining the amount of work that should be contracted as we always supplement our own forces largely by resorting to contracting.

Use of Charts and Reports for Work Control—Assume that a new substation project has reached a stage wherein work can be started. This implies that a schedule has been set up, funds authorized, equipment ordered, and the construction order released. Plans are received. The load control charts indicate that all work can be handled by our own forces; work orders, therefore, are issued to the various sections authorizing them to proceed with their portion in accordance with plans and instructions governing the job.

The weekly progress report now enters into the system of control. The weekly meeting during which the work is discussed familiarizes the foreman and section engineer with the various phases of the work; the report shows its progress—gives reasons for delays if any, so that proper steps may be taken to have the causes for delay removed. It furnishes information so that all other elements of the project may be properly co-ordinated and controlled.

WEEKLY CREW LINE-UP
Week of Oct. 18, 1926

ELECTRICAL FORCES

Valley Sub. C.O. 6270-D	13th Street Sub. C.O. 6205-D 6255-D	Grant Sub. C.O. 6320-D
J. Purcell	F. Railand	E. Graul
J. Craig	J. Risentrant	J. Sullivan
W. Whitworth	Lockhart	E. Johnston
H. Nolton	E. Hufnagel	R. Munch
W. Robertson	J. Stepp	J. Surenda
	B. McCullough	
	H. Fagan	
Stanwix Sub. C.O. 6337-D - 241	F. Reilly	
	A. Carson	
	H. Hartranft	
W. Geiser	H. Moss	
R. Lewis	H. Huff	
etc.	etc.	

FIG. 7—SAMPLE OF WEEKLY CREW LINE-UP REPORT

The financial statement included in the semi-monthly report is useful to section engineers and to the foremen having charge of the work. It answers the question: "How much money is authorized to complete the given job—how much has been expended—and is the balance sufficient to carry it through to completion?" These data are available while the work is in progress.

When the weekly progress report shows that a project is not progressing so rapidly as it is expected, reference to the crew line-up may indicate that a crew, or certain part of it, may advantageously be transferred to the job in question; or, if the semi-monthly report shows an expenditure greater than anticipated, the crew line-up report may also indicate that too many "A" mechanics, drawing a high rate of pay, are being used. Obviously, no advantage would be gained, from the standpoint of lower costs, to maintain skilled electrical mechanics on work requiring those possessing less skill.

Conclusion—The charts and reports, in brief, make up the work control system as practiced in the construction division of the Duquesne Light Co. We believe the system to be of the right sort—it adequately takes care of the work as it is intended to do and it is as simple as we can make it. It tells the whole story—work on hand, availability of labor and its location, progress of jobs from week to week, and the expenditures.

Mississippi Problem Outlined by Chief of Engineers

Levees Must Continue to be Chief Line of Defense—Spillways Possible in the Lower Part of the Valley—Reservoirs May Have Some Effect but not Available to Control Flood

SPEAKING before the Flood Control Congress held in Chicago June 2-4, Major General Edgar Jadwin, Chief of Engineers, U. S. Army, described the work already done looking toward the control of the Mississippi River, outlined proposals for further control and gave his views as to why the levee system must be looked upon as the chief line of defense. Not only as a concise description of the Mississippi situation but also as an authorized statement by the head of the governmental body charged with the control of the Mississippi River, General Jadwin's speech is of interest. Except for a few paragraphs, it is given below.

The flood of the Mississippi Valley now culminating is in many ways the most serious catastrophe of its kind in the history of our country.

As is always the case after a great flood, many remedies are now being suggested, some of which are obviously impracticable, others of which are plausible to those not familiar with the problems that must be overcome in controlling the flow of so vast a stream as the Mississippi.

The waters from some 31 states pour into the Mississippi, and were it not for the protecting levees, the worst floods would normally overflow some 30,000 sq. miles—territory greater than many of our states. The people of the valley themselves started the building of protecting dikes or levees which have been extended and enlarged to their present size. The local people contributed to the limit of their resources. Their aggregate contributions before receiving any assistance from the federal government were over 100 million dollars. In 1879 the federal government took formal cognizance of the situation and organized the Mississippi River Commission, and from that date until this has participated in the cost—the last few years to a greater extent than previously. This commission is composed of seven men—six of them engineers and one a business man; three of them from the Army, one from the Coast and Geodetic Survey, and three from private life. It has been charged under the supervision of the Secretary of War and the Chief of Engineers with the duty of preparing plans and executing the work.

Since the Commission was organized, it has supervised the expenditures of some 90 millions of dollars on levees. Of this some 15 millions was contributed by the delta people. But the local people and the commission have always been expending their funds in such a way as to secure the greatest immediate result from them. As they have never had a project or an appropriation ample to take care of the greatest flood, they have done the best they could with the money at hand. Their objective in 1922 was increased to a project intended to provide against a flood slightly greater than that of 1912 and 13. This called for the expenditure, in addition to that on work previously done, of 60 million dollars by the federal government. Part of this appropriation was to be expended for dredging for navigation and part upon revetments to control caving banks. The portion expended on levees was by law required to be matched by half an equal sum contributed by the local people. Thirty million dollars, or one-half of the total sum, had been spent on this partial objective when the present flood started.

The levees as they have been extended under these appropriations have steadily increased their power of protection. They had reached a state of strength which protected completely against the usual annual floods. They had been giving greater and greater protection against the larger floods which, though varying in size, came on an average of about one in five years. They have even reduced the areas inundated and losses incurred in the really great floods.

It is obvious that a system designed to take care of a flood of the size of those of 1912 and 13, but lacking 30 millions of dollars of appropriations for such work, could not, bravely as it might try, protect completely against a flood greater than any the country had ever previously experienced and some 4 ft. higher than those of 1912 and 13. It is, however, a source of gratification that it did completely protect over one-third of the land which is subject to inundation, and that, in addition, it so delayed the action of the water in reaching the areas inundated that time was afforded for the rescue of life. Of the 114 lives lost, 106 were lost in the first rush of the flood. Only 8 more are known to have been lost since the co-ordination of the rescue service was placed under Colonel Spaulding of the Army Engineers.

Nearly all breaks or crevasses in the government levees have occurred in levees on the main river that had not yet been built to standard grade and cross-section. This is interesting in view of the fact that the dimensions of these levees were based on the lower flood of 1912-13. Most, if not all, of the other crevasses were in levees on the tributary rivers constructed by local authorities, generally with smaller cross-section and strength than the government levees.

Revision of Present Project—The need for a revision of the government project rests primarily on the following propositions: First that this flood has shown that protection must be furnished throughout against greater floods than those which existing works were expected to meet even if all works contemplated by the present authorization had been completed; second, levees necessary for the protection of this great endangered region and not heretofore under the government jurisdiction should be brought thereunder; third, the problem is now manifestly national; fourth, the percentage of participation of the heavily taxed districts must be reduced; fifth, the law should be so modified that the government shall have sufficient definite authority promptly to locate the works where the soundest engineering indicates they should be built, whether this involves larger levees, some strengthened and spaced farther apart, or spillways or reservoirs, or a combination of all these structures.

In the re-analysis of the situation there are many phases which have to be taken up and covered—among these, we must determine what the maximum flood may be. One of the most reliable and practicable ways of doing this is to study measurements of the worst floods which have actually happened within the knowledge of man. These include those of 1844, 1882, 1912-13, 1922, and lastly the flood of 1927. From these positive cases and from meteorological studies we must make our deductions as to the greatest runoff against which protection should be furnished. Present indications are that we must prepare to care for not less than 2,500,000 sec.-ft. We must determine the height which such a flood will attain at various points in the valley. This being done, we are prepared to consider the methods of handling it. Many methods have been suggested. Those which have been discussed most frequently are reforestation, reservoirs, levees, and spillways. Various freak methods have also been suggested, which can be proved to any man of good judgment and honest mind to be impracticable and therefore not worthy of serious consideration.

By authority of the Secretary of War and with the approval of the President, I have requested the Mississippi River Commission to study this problem carefully and am expecting from them about Oct. 1 a careful estimate of the cost of raising, strengthening, and spacing the levees to provide against the greatest possible flood; also their views on the various alternative propositions and the extent to which, if any, it will be advisable to substitute these alternative systems for the raising of the levees. The commission will also report upon any changes found desirable in the navigation project. Let me discuss briefly a few of the methods often proposed for flood control.

Reforestation—Reforestation in itself is most desirable. Let us plant trees as we plant crops of wheat or cotton.

Lands that cannot be cultivated with economy and profit to the farmer, by all means should be made to produce timber if economically feasible. Let us reforest every such area capable of being so used.

The effect of forests upon flood flow has long been under discussion. It will take many years for trees to grow and the humus to form under them sufficiently for reforestation to be a real factor in the practical solution of flood prevention in the Mississippi basin. They will probably furnish greater uncontrolled absorption. This will sometimes be an advantage and sometimes a disadvantage. This action will be outlined later in connection with remarks on reservoirs. The fact that the greatest recorded flood of the upper Mississippi past St. Louis occurred in 1844, while the northwest was covered with its primeval forests, indicates that complete relief cannot be expected from reforestation.

The reservoir system will be a fine solution if it can be applied successfully and at a reasonable cost. It has received an impetus from the fact that it has been applied successfully for the flood protection of several small areas and from the fact that reservoirs built solely for power purposes on smaller streams have been noted to have an advantageous influence in decreasing somewhat the flood heights and increasing slightly the low-water flows needed for navigation purposes.

Reservoirs—Reservoirs of various types have been suggested: Detention reservoirs, which are self operating and permit, as long as there is water in the reservoir, a constant flow, which at no time exceeds the bank capacity of the effluent river; completely controlled reservoirs on the headwaters; reservoirs at intermediate locations on the main lines of the principal tributaries; and lateral reservoirs in the low-lying or delta lands in the Mississippi Valley itself.

The best regulated river in the world is probably the St. Lawrence. This river secures its regulation through the natural reservoir capacity of the Great Lakes. The Mississippi does not have the advantage of such deep, great natural reservoirs. It likewise carries about three times the amount of water in a year carried by the St. Lawrence. It is patent, therefore, that to secure as good a regulation as that of the St. Lawrence in the same way would apparently require about three times as many Great Lakes as does the St. Lawrence. In other words, to secure such a regulation we would have to find sites along the Ohio and its tributaries, the upper Mississippi and its tributaries, the Missouri and its tributaries, and the main stem of the Mississippi for some fifteen Great Lakes the size of those which now furnish so beneficent a regulation of the St. Lawrence. This is impracticable as the land which they would cover, were the sites available, would include many of the greatest cities of the country and cover an area greater than the 30,000 sq. miles of the land which we are aiming to protect. But fortunately we do not need as good a regulation as that of the St. Lawrence, and the fact that reservoirs may not completely displace levees is not proof that they may not be of value for part of the control. We can stand a very much greater fluctuation in the Mississippi than in the St. Lawrence and still protect its alluvial lands.

It must be borne in mind that it is generally not the water flowing out of the mountain streams but rather the rains falling on the alluvial basin of the river itself that create the greater part of the floods of the Mississippi. An examination of the rainfall in the Mississippi drainage basin during the months of March and April, which rainfall was primarily responsible for the last flood, shows that a maximum of 25 in. occurred in most of the basin below Memphis, with gradually diminishing amounts to the east, north and west, until we find less than 6 in. falling in the section beyond Pittsburgh, Dubuque, Sioux City and Guthrie. This year, with a record flood culminating in the lower Mississippi, the upper reaches of the Ohio River were at so low a stage that it was necessary to raise the navigation dams in order to hold enough water to preserve navigation. In the flood of 1913, if all the water flowing past Pittsburgh on the Ohio, all that flowing past St. Paul on the Misssissippi, and all that flowing past Sioux City on the Missouri, had been held back by reservoirs, the flood waters south of Cairo would have been reduced by only about 2 per cent.

One thing we must not lose sight of in studying reservoirs is that the flood waters of the Mississippi come from many tributaries, the principal ones in the northern section of the country contributing their waters by way of the Ohio, the upper Mississippi, and the Missouri. The flood heights of the lower Mississippi, while extending over a longer period, will not be so great if these three main tributaries deliver their waters seriatim rather than simultaneously. They ordinarily do this naturally—the Ohio most frequently discharges its water first, then the upper Mississippi, then the Missouri. If, for example, large absorptive power is furnished on the Ohio in a normal year, less water goes down at first, but a greater quantity is fed in by the Ohio later when the upper Mississippi and the Missouri are in flood. If this happens at the time of the greatest flood, extra absorptive power in the Ohio would obviously be a detriment, whether furnished by reservoirs or reforestation.

While the reservoir system has been discussed generally by many engineers, and in full detail for a few relatively small localities, it has never been threshed out completely for the valley as a whole. We have decided to take it out of the realm of loose conjecture and have instructed the district engineers who have charge of the tributary rivers between the Rocky Mountains and the Appalachians to make studies of the possible reservoir sites in their districts. Their reports will be available to the Mississippi River Commission. We have also constituted a reservoir board which will analyze and summarize these reports and determine what such a system would cost; also what parts of it, if any, can best be utilized to take off part of the crest of the flood and what the cost will be.

Cost of Reservoirs—An inkling as to the cost of flood control by headwater reservoirs if available only for flood control purposes, may be had from the fact that the Dayton Flood Control District wisely expended in the neighborhood of $30,000,000 to control the floods of relatively small areas on relatively small tributaries of a tributary of the Ohio, itself a tributary of the Mississippi. It is interesting for the sake of comparison to note that this sum which protected so small an area if added to the funds applied before this flood on the main Mississippi levees would have completed them to a grade above that attained by any flood prior to 1927.

It has been suggested that flood control reservoirs would likewise be available for power, irrigation and, indirectly, drainage purposes. It is generally considered by those most familiar with water power development to be impracticable to use the same reservoirs for power and flood control because the theory of flood protection reservoirs is that to function best they should be empty when the flood waters arrive in order that they shall be able to hold the most flood water; whereas power reservoirs should be as nearly full as possible at all times in order that water may always be available to run out when and as needed for the development of power. While this difference of function is fundamentally correct, it has been found in actual practice in some cases that power reservoirs, by virtue of the fact that they cannot always be kept full, are sometimes available to a limited extent for the conservation of flood waters.

Reservoirs in the upper rivers would be of value in the regulation of local floods—a help to navigation and a benefit to power in the upper tributaries—but it remains to be seen what their effect is on the floods in the main trunk of the Mississippi from Cairo to the Gulf.

Lateral reservoirs along the main stem of the river have likewise been suggested as a possibility of caring for part of the crest temporarily. The places suggested for consideration are the least valuable lands, particularly swamp lands near the mouths of some of the principal tributaries. This subject is also being investigated and offers a strong hope of assistance.

The bed of the stream below the banks and the area between the existing levee lines is itself a huge storage reservoir, located in a place where maximum benefits are secured from storage of surplus water. Moving back and straightening somewhat the line of the existing levee system is a solution that appeals to many, as it secures additional reservoir space and permits a wider channel, if needed for increasing the volume of flow to the sea and permitting flood waters to escape more rapidly.

All remedies involving reservoirs must be studied and tested in the light of cost and general economic desirability.

There are now in the main river 1,815 miles of levees averaging about 18 ft. in height.

The resultant experience of many men of great thought,

extending over many years, has heretofore led those who have been most concerned in the protection of this land to the conclusion that they must rely mainly on levees.

A widespread fallacy about levees is the assertion that they raise the bed of the river, so that in the long run they will result in the formation of an elevated trough. The surveys and measurements carried on for over half a century do not show that the levees have appreciably raised the bed of this river in this period.

There is little doubt in the minds of the farmers and planters of the valley, who have reclaimed its swamps and converted them into the most fertile portions of this great country, as to what the remedy should be. The increases in land values in these states in recent years have been largely in the reclaimed parts. Most of these farmers believe that the only direct and sure remedy is the construction of levees high enough and strong enough to withstand the floods. No computation yet produced shows the contrary.

There is, however, a question as to whether levees should provide all of the protection or whether enough water may be held back by reservoirs to enable us to function with lower levees than if the entire flow were so handled.

Spillways—A further system of relief which is receiving careful attention is that by spillways. The most probable place for the use of these is in the lower portion of the valley where the river has a flatter slope and where there is the greatest possibility of providing routes of reasonable length to the Gulf for a portion of the waters.

While it is possible to afford protection by levees to New Orleans, the cost, engineering and other consideration on the one hand of raising its wharves, adjusting rail communications and otherwise revamping the port facilities to meet an increased levee height, or on the other hand of giving a greater width of river in Lower Louisiana, would be great and must be compared with other measures.

This matter is by special act of Congress being considered by the Spillway Board which expects to be through with its deliberations by Sept. 1. This board has conducted for over a year studies of flood control on the Mississippi below Old River. While all of its detailed conclusions and recommendations are not yet available, enough has been determined to make it certain that it will recommend a solution which supplements the levee system with one or more spillways.

All these studies of the various phases of the problem of controlling the floods of the Mississippi are being carried on assiduously. We have engaged on them at present some 75 engineers, about 30 of whom are officers and 45 are civilians. It is our intention to leave no stone unturned to find the most practical technical solution for the problem, and it is our full expectations that we will be prepared with this some time on or before December first.

We are making this comprehensive study in the full assurance that it is the right method, and it would be a satisfaction to us to know that this course meets with your approval.

The problem in the past has been to raise funds to protect against the record stages of previous floods. It should now be recognized that we must aim higher. This work will undoubtedly cost millions of dollars. It is largely a national work, more so than has heretofore been conceived, for the reason that the raising of the levees in one part of the river inevitably brings greater flood hazard to those below, and the works throughout the many states must be prosecuted as one complete and co-ordinate whole. The disasters accruing from an insufficient flood protection of the valley of the Mississippi are not local in effect, but react on the producers, consumers, manufacturers, distributors and investors in all parts of the country.

Let us keep our feet squarely upon the ground, let us not defer the provisions of adequate protection too long by chasing visionary rainbows with unwise complications. This is a time for sound and clear thinking.

The waters concerned come from a great variety of states and inflict their damage primarily on a limited number— some seven; at the same time we have an abiding confidence in the disposition of the country at large to treat all of its citizens fairly and to recognize that so great a threat hanging over the heads of seven sovereign states is in reality a threat and a challenge to the entire nation. It is less serious only than war itself, and must be met squarely and without delay by the nation as a whole.

Girders of Welded Building Tested with Hydraulic Jacks

Two Girders of Sharon Building Tested to Double Load—Novel Test Rig—Deflections Verify Continuity

By GILBERT D. FISH
Consulting Structural Engineer, Westinghouse Electric & Mfg. Co., New York

A FEW weeks ago a severe load test was made by the Westinghouse Electric & Manufacturing Co. on a pair of 20-in. I-beams in the fourth floor of its arc-welded steel factory building recently erected at its Sharon Works by the American Bridge Co. and described in *Engineering News-Record* of Jan. 20, p. 102. The testing method employed and the results obtained in this test were sufficiently novel to be of interest to structural engineers and contractors.

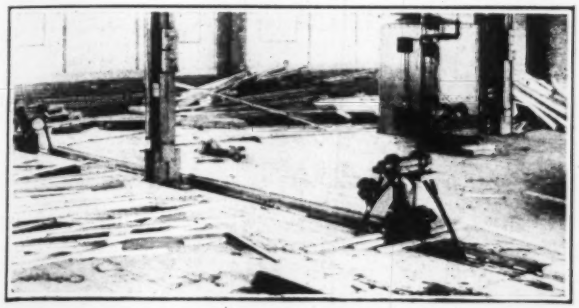
The beams tested were adjacent main girders, selected at random from the many members of the same size and like arrangement occurring on typical floors of this building. The reason for selecting adjacent beams for test was that an essential part of the design of this building was the continuous construction of all interior beams and girders, and the chief interest of this test consisted in demonstrating that complete continuity actually existed between two adjacent members. The narrow dimension of the building is about 70 ft., made up of three equal girder spans of 23 ft. 2 in. c. to c. of columns. The 20-in. girders carry 15-in. I-beams at their quarter points, dividing the 23-ft. span into four floor-plank panels; on these I-beams is laid a 4-in. plank floor with 1-in. wood finish floor.

The loads were applied near the mid-points of the middle span and one of the two adjacent spans, the third span remaining unloaded. Loading was accomplished by means of hydraulic jacks, reacting against a yoke of turnbuckle rods extending from the jacks to the columns at points slightly under the floor next below. Attachment to the columns was by saddles made of heavy round steel bars welded into angle irons, these saddles being temporarily welded to the columns for the test.

The loads on the two beams were applied nearly simultaneously in order to avoid overloading either one of the beams due to unbalancing of the forces at the higher loads. Loads were increased in approximately equal increments of about 25,000 lb. up to 75,000 lb. and were finally increased to 82,900 lb. each. Vertical deflections of the two beams were measured at or near the mid-points and quarter points of the two spans by means of calibrated steel wedges inserted between tops of beams and the points of suspended plumb-bobs. The elastic deflections of the two loaded beams at the maximum loading were as shown in Fig. 2. The upper curve represents the elastic curve as calculated, the diameters of the columns being deducted from the center-to-center spans; 30,000,000 lb. per sq.in. was used as modulus of elasticity. The agreement between the observed and vertical curves is as close as would be expected in structural tests and calculations, especially in view of the rather coarse method used for measuring deflections. It is not unlikely that the differences are due at least in part to the excess moment of inertia of the beams with their top and bottom reinforcement near the columns. At all six plumb-bobs the deflection re-

maining after removal of loads was approximately 0.005 in., indicating that no material set had been produced in either of the beams.

As shown in Fig. 2 the calculated bending moments at the column between the two loaded beams and at the point of loading of the outer beam were very close to the elastic limit of the steel. A 20-in. I-beam, 65.4 lb. per ft., carrying a center load of 82,900 lb. and supported between two columns at the same distance apart by means of standard riveted connections, whether of the side angle type or of standard seats and stiffeners with top angles, would be stressed so nearly to its ultimate resistance that it would be bent and probably buckled beyond recovery. It seems to be clearly established that the beams tested have been rendered truly continuous by the welded connections and have in fact



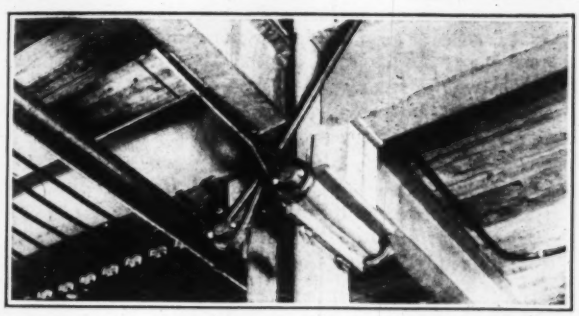


FIG. 1—JACKING YOKE AND LOWER ANCHORAGE

the resistance contemplated by the design. Attention is invited to the fact that 24-in. I-beams, 79.9 lb. per ft., were called for in the alternative riveted design which was prepared for this building.

While this method of testing may not be sufficiently cheap to make it a practical matter to test the beams and girders throughout a building, yet it is so much less expensive than assembling pig-iron and sand bags for weight tests that it seems to be a valuable substitute for the more familiar method, where suitable anchorage can be obtained. In the case of the Sharon test, the method could at a slight additional expense have been extended to many other pairs of girders and to many pairs of secondary beams as well, had it not been for the fact that the flooring had been laid throughout the building before the test was made; considerable trouble and some expense were entailed in tearing up flooring to allow the rods to pass. In the case of a steel-frame building, tested before the laying of floors, the apparatus could be set up very quickly and a considerable number of tests could be made in a short time.

It should be pointed out that the test at Sharon was not made because of any doubts on the part of those concerned as to the actual strength of the welded connections, but rather to demonstrate an inexpensive method of testing which could be applied to an arc-welded structure or any other kind of structure when

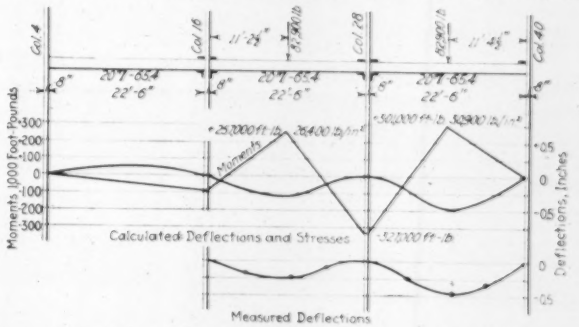


FIG. 2—DEFLECTIONS UNDER TEST LOAD

required by building departments or others who might be skeptical.

The test was planned and results interpreted by the writer. A. M. Candy and R. L. Helquist, Westinghouse engineers, supervised preparation of the equipment and conducted the test. The testing as well as the construction of the welded building has been under the general direction of W. S. Rugg, vice-president of the Westinghouse Electric & Manufacturing Co.

Railway Grades at Grade Separations

IN PROBLEMS of grade-crossing elimination an important consideration may be the rate of grade for the railway connection or incline between the normal level and its elevated or depressed tracks, as the selection of this grade may affect the number of street crossings. Some examples of such runoff grades are noted below:

	Per Cent
Illinois Central R.R.; fly-under junction for South Chicago Branch; electric suburban traffic	3.00
Grand Central Station, New York; suburban approach tracks	2.7 and 3.00
Pennsylvania Station, New York; approach tunnels; electric locomotives, main-line trains	1.3 and 2.98
Delaware, Lackawanna & Western Ry.; runoff for East Orange track elevation	1.50
Grand Trunk Ry.; runoff for Detroit track depression	1.00
Grand Trunk Ry.; temporary connection	2.50
Northern Pacific Ry.; runoff for Spokane track elevation	1.00
Illinois Central R.R.; runoff at Champaign track elevation	0.60 and 1.00
New York, Chicago & St. Louis Ry.; grade separation at Grand Crossing, Chicago	0.638 and 1.00
Chicago, Rock Island & Pacific Ry.; runoff for Chicago track elevation	0.50
Chicago, Rock Island & Pacific Ry.; temporary runoff	1.50
Chicago & Western Indiana Ry.; temporary runoff for Chicago track elevation	1.50
Chicago & Northwestern Ry.; track depression at Milwaukee	0.50 and 0.72
Chicago & Northwestern Ry.; industry connections	3.50
Chicago, Burlington & Quincy Ry.; approaches to Aurora track elevation	0.20 and 0.30
St. Paul Union Station; approaches	0.30
Indianapolis Union Ry.; industry connection	2.60
Pennsylvania R.R.; incline from elevated tracks to Detroit team yard	3.00
Chicago, Indianapolis & Louisville Ry.; incline from Indianapolis elevated tracks to team yard	3.00

It will be seen that the maximum is 3 per cent in two cases, both for electric operation with multiple-unit suburban trains. For main-line operation with electric locomotives, the maximum is a little under 2 per cent. For main-line steam operation, grades of 1 per cent appear to be generally used, with 1½ per cent as a maximum. For temporary runoffs used during the progress of the construction work, grades of 1½ to 2½ per cent have been used, while industry connections to elevated and depressed tracks vary from 2 to 3½ per cent.

The Seismograph and the Engineer

Scientific and Practical Objects—Strong-Motion Seismographs—Charting Active Faults from Minor Disturbances

By N. H. Heck

Chief, Division of Terrestrial Magnetism and Seismology, U. S. Coast and Geodetic Survey, Washington, D. C.

At a recent meeting of the Eastern Section of the Seismological Society of America at Cambridge, Mass., where the engineer joined in discussion of earthquakes with the geologist and seismologist, the statement was made that the seismograph is the instrument of the superscientist and not of use to the engineer in designing buildings and structures to resist earthquakes. The argument was based on the well-known fact that in the central region of a severe earthquake the earth's movement is likely to be great enough to destroy the seismograph itself or at least to make the record valueless. The fact is undeniable, but it is only part of the story, and a solution could have been found long since if there had been more interest in the subject on the part of engineers.

This lack of interest has been unfortunate, because the desired information can be obtained only at the time of severe earthquakes and so recently as 1906 there were no instruments in the California region to record just what happened when there was slipping along the San Andreas fault. It has been proved that it is quite possible to obtain what the engineer wants, as even in the very destructive Tokyo-Yokohama earthquake a strong-motion seismograph or tromometer made a continuous record at the Tokyo Imperial University. While the U. S. Coast and Geodetic Survey, which is now charged with seismological investigation on behalf of the government, approaches all its problems from the practical viewpoint, it is not able to endorse the view that the seismograph is an instrument purely for the superscientist and that it cannot make a most important practical contribution to the engineer. It is well that such points are raised by prominent engineers, so that they may be adequately discussed.

What Needs to Be Learned—Engineers want to know exactly what happened during an earthquake, so that they may obtain an adequate picture of the stresses in a building. The better type of seismograph is entirely unable to do this since the destruction of the instrument may happen and in any case the record will be largely off the sheet. To accomplish the purpose it will be necessary to place strong-motion seismographs throughout a region where an earthquake may be expected and then simply wait till an earthquake occurs. Any group of engineers who wish to undertake this will have the co-operation of seismologists both in design and installation. It is even possible that there might be co-operation with Japan in such work, as that country is certain to have earthquakes at short intervals. Results should be accumulated from all the types of earthquakes.

However, the viewpoint of the seismologist as to his duties toward the engineer and the public whom both serve goes beyond this one problem. The engineer is on the frontier in the conflict with nature and sometimes nature wins. The engineer is forced to design for definite conditions. In designing a bridge he is not always able to take into account the maximum flood. It has been shown that it is extremely difficult to keep a great river under control when rainfall occurs over the entire basin at the same time. Similarly, few buildings can stand the greatest earthquake known to have occurred. In this country we have, however, a different problem. Some of the earthquakes occur along definite fault lines and it is known that the danger is very much greater immediately over or near the fault than at a distance on either side, also that made land or beds of alluvium are shaken much more severely than well consolidated or rock areas.

Where a fault reaches the surface earth action is found by study of history, but many faults exist in places where the surface shows no evidence whatever. Just like the geologist, the engineer is helpless, and he has much more at stake. This is where the seismologist, using the most delicate seismographs known, the kind for the use of the "superscientist," can come to the rescue. His instruments need not even be placed where great destruction is likely, but may be 100 miles away. The essential thing is to place them in such positions as to make it possible to obtain the earthquake epicenters (the point on the earth's surface directly above the place where the earthquake's shock of maximum intensity occurred) by triangulation from a number of stations. If such epicenters can be definitely associated with a given fault and the number can be determined, sooner or later it will be possible to trace the unexposed faults with considerable accuracy and to know their state of activity. It is by no means impossible that some day it may be found expedient to have park areas directly over formations definitely known to be dangerous, or at least that requirements for buildings and structures may be very much more rigid in such places.

Special Studies—It is of interest to note that the Carnegie Institution of Washington assisted by government departments, universities and business organizations is studying parts of the San Andreas and other faults in California in this very manner, though the study is scarcely started. Part of the program of special interest to engineers is precise triangulation and leveling from time to time to detect vertical and horizontal changes resulting from earthquakes or the slow creep of the earth's crust.

Especially in questions of bridges, water supply and sewerage systems are engineers concerned with earth movements. The time may come when relation to earthquake activity in certain regions may be the governing consideration, rather than purely terrain and population density conditions as at present. The engineer will have to depend both upon the geologist and seismologist and the former will have to depend upon the latter in advising the engineer. It is important that these possibilities be brought home to the engineer and also to the seismologist, as the latter may otherwise become too deeply interested in the purely scientific side of his study.

Attention of engineers is also called to the fact that the catalog of earthquakes in the United States found in the quarterly seismological report of the Coast and Geodetic Survey is at least partially based on seismograph records. As time goes on this information, especially as shown on maps at the close of each year, will define for the engineer the places where the earthquake hazard should be taken into account.

Many-Sided Activities of Water-Works Men

Abstracts of Papers and Discussions Before the American Water Works Association—Problems of the Superintendent, Engineer and Manufacturer

FROM the scores of papers and reports presented last week at the annual meeting of the American Water Works Association in Chicago enough have been selected for abstract to give a representative idea of the scope and value of the technical proceedings, which will eventually be given in the association's *Journal*. A summary of the business transacted is given in our current news section.

* * *

Compensation of Executive and Technical Heads of Water-Works

By W. W. Brush
Chief Engineer, Department of Water Supply, Gas and Electricity, New York City

SALARIES of the chief executive heads of 45 American water-works in cities of various sizes range from $2,000 to $12,000 a year ($1,200 to $7,200 on pre-war basis). Grouped in population classes these salaries, together with the corresponding annual water revenues, are shown in the accompanying table.

SALARIES OF MANAGERS OF 45 WATER-WORKS

Population	Revenue	Salary	Average
15,000 to 25,000	$74,000	$6,000	$4,350
	92,000	2,700	
25,000 to 50,000	130,000	4,500	
	186,000	3,300	
	325,000	3,500	
	189,000	5,000	4,075
50,000 to 75,000	200,000	3,600	
	210,000	4,500	
	420,000	6,000	
	410,000	5,000	
	242,000	3,600	
	220,000	3,500	
	300,000	4,680	
	203,000	2,280	4,140
75,000 to 100,000	75,000	2,000	
	193,000	5,400	
	316,000	2,940	
	231,000	3,500	3,460
100,000 to 200,000	275,000	3,600	
	200,000	3,600	
	615,000	6,000	
	400,000	4,500	
	749,000	8,000	
	550,000	4,200	
	536,000	8,250	
	839,000	4,500	5,450
200,000 to 350,000	967,000	5,000	
	1,600,000	12,000	
		4,400	
	500,000	3,300	
		5,000	
	1,318,000	4,968	
	1,616,000	5,000	
	1,445,000	4,500	5,521
350,000 to 500,000	970,000	4,800	
		10,000	
	2,000,000	7,500	
	1,645,000	6,000	7,055
500,000 to 1,000,000	2,651,000	6,000	
	2,816,000	5,000	
	3,432,000	7,000	6,000
	5,500,000	5,500	
Over 1,000,000		10,000	
	7,036,000	10,000	
	22,000,000	12,000	9,375

Unrest and dissatisfaction with the monetary return in the water-works field is virtually universal, especially in the municipal service. Those who have been long in service have had to reduce their standard of living and many have taken up night and Sunday work. The low salaries offered do not attract men of suitable training and ability. The lowest salary in the list ($2,000) is less than the wages of many unskilled laborers.

It is suggested that the danger to the community resulting from this condition be presented to public officials and others; that the American Water Works Association set up a proper schedule of compensation, bring it to the attention of public officials and point out instances of unreasonably low salaries; that the interest and aid of civic associations be enlisted; that efforts be made to raise the salaries of subordinates.

[On motion of Mr. Brush, the convention voted to request the president of the association to appoint a committee to consider the feasibility of formulating a schedule of minimum rates of compensation.]

* * *

Activities of Underwriters Laboratories on Water-Works Equipment

By Dana Pierce
President, Underwriters Laboratories, Chicago, Ill.

INVESTIGATIONS conducted by Underwriters' Laboratories having the most direct bearing on water-works practice are those relating to pipe and pipe fittings intended for public water supplies and private fire service connections to such supplies, and those relating to gate and check valves, indicator posts, hydrants, fire service meters, and detector check valves.

The Laboratories has also conducted an extended investigation of the steel pipe produced by one of the largest manufacturers of this kind of material, but "label service" has not as yet been extended to cover its production.

In making examinations and tests of pipe, our engineers consider the raw materials entering into the pipe, make transverse and tensile strength tests on test bars, chemical tests from borings taken from the finished pipe, and tests for the hardness and the crushing strength of the pipe. Tests are also made of the strength of the pipe under hydrostatic pressure, the holding power of the joints and of the ability of the pipe to withstand movement resulting from shifting of the buried lines. The test work is supplemented by a thorough examination of the pipe, and a study is made of the foundry facilities provided and the shop practice followed in its manufacture.

In cases where the results of an investigation eventuate in the inauguration of "label service" on pipe, detailed specifications are prepared by the Laboratories for the guidance of the manufacturer and the Laboratories' inspectors covering the things required of the product, and the conduct of the inspection work. [The paper also outlined the other lines of investigation named in the opening paragraph.—Editor.]

* * *

Cast-Iron Pipe Developments

By H. Y. Carson
Research Engineer, American Cast Iron Pipe Co., Birmingham, Ala.

THE most striking development in the cast-iron pipe industry has been the manufacture and introduction of centrifugally cast pipe. This material is of closer grain, greater strength and lighter weight when compared with the standard adopted by the American Water Works Association. Making pipe by the centrifugal method gives promise of some material reductions in the cost of pipe, but sufficient time probably has not elapsed to determine this point.

The making of long sections of bell-and-spigot pipe by welding together ordinary standard lengths is now an established practice, but as the technical phases of this work have been printed elsewhere repetition is unnecessary (*Acetylene Journal*, March, 1926; also *Gas Age-Record*, May 7, 1927, p. 659). The art of bronze-welding cast iron has many other useful applications. It not only simplifies and reduces the cost of complicated fittings, but it is becoming more used for repair work in general.

Pipe foundries are now equipped to furnish cast-iron pipe lined centrifugally with cement mortar approximately ½

to ⅞ in. in thickness. Depending upon the size of pipe, the velocity of water and corrosiveness or other chemical characteristics, it can be safely stated that the cement lining for pipe generally brings about an increase from 10 to 50 per cent of flow capacity with the same unit drop in pressure. In most instances, cement-lined mains give assurance of being far more dependable than tar-dipped pipe and for these reasons the writer believes that cement-lined cast-iron pipe will become standard even where the water has no highly tuberculating effect.

* * *

Friction Losses in Tar-Coated and Cement-Lined Cast-Iron Pipe

By M. L. Enger
Professor of Mechanics and Hydraulics, University of Illinois, Urbana

TESTS recently conducted by the University of Illinois on 4-, 6-, and 8-in. cast-iron pipe to determine the friction losses due to the inside coating of the pipe showed that in the 4-in. size the cement-lined pipe had a greater friction loss, but as the velocity of flow was increased this difference became less. In the 6- and 8-in. sizes the cement-lined pipe had a lower friction loss and the difference in friction losses increased as the velocity of flow was increased to 10 ft. per second. *Discussion*—J. E. Gibson stated that his experience with cement-lined cast-iron pipe showed that it had a higher sustained carrying capacity than the tar-coated pipe.

* * *

Pumping Station Design and Its Future Development

By A. L. Mullergren
Consulting Engineer, Kansas City, Mo.

THIS PAPER covers in detail the design of three large pumping stations recently completed or under construction, in Cleveland, Chicago and St. Louis. The recent development of high-duty pumping equipment, together with improvements in boiler design and the use of auxiliaries, has made very high efficiencies possible. A comparison of the high-duty triple expansion engine with the steam turbine showed the latter to have a considerable lower annual cost in the larger units. Increased steam pressures and the use of superheated steam; use of boilers of 500 to 1,000 hp. operating at 200 per cent rated capacity; auxiliary equipment driven by steam turbines or by electricity were some of the tendencies in large modern pumping stations.

In smaller pumping plants, electrically-driven centrifugal pumping units, using power from large central stations, seem to be the prevailing tendency. By use of synchronous motors, over-all efficiencies of as high as 84.7 per cent have been secured.

* * *

Sedimentation Studies of Turbid American River Waters

By A. W. Bull and G. M. Darby
The Dorr Co., New York City

SINCE 1923 The Dorr Co. has been making sedimentation studies of the waters of some of the turbid rivers of the Middle West. This paper presents the summarized results of these studies with a comparison of the settling behavior of the different river waters. The work has been carried out along several different lines: (1) Comparative clarification tests in 1 liter cylinders; (2) comparison of clarification tests in cylinders with clarification in a continuous clarifier; (3) clarification tests in deep cylinders; (4) studies of sludge deposition, sludge thickening and sludge discharge; and (5) studies of the advantages of sedimentation prior to flocculation. [Each line of study is described in the paper.—Editor.]

The advantages of pre-sedimentation in the treatment of highly turbid waters may be summarized as follows: (1) The reduction of turbidity results in a substantial saving in chemicals required for coagulation. (2) Pre-sedimentation furnishes water uniformly low in turbidity for secondary coagulation resulting in smoother plant operation. (3) Pre-sedimentation removes the bulk of the suspended solids, thereby greatly reducing the accumulation of solids in the coagulating basins with a resulting saving in the cost of cleaning these basins. (4) The water discharged with the solids from the pre-sedimentation basins has not been chemically treated. The cost of water wasted in the sludge is therefore less in the case of pre-sedimentation than when the raw water is directly treated with coagulants. (5) Where the water is to be subsequently softened, preliminary tests indicate that pre-sedimentation will effect a considerable saving in lime.

* * *

Well Construction Sanitation

By W. Scott Johnson and H. A. Buehler
Chief Sanitary Engineer, State Board of Health of Missouri, and State Geologist of Missouri, Jefferson City

IN SEEKING to secure satisfactory well construction from the sanitary standpoint, various specifications have been formulated. Of these the one proposed by the State Conference of Sanitary Engineers is probably the most thorough. While these specifications are entirely satisfactory in securing proper well construction with regard to many sanitary features, they are inadequate as regards others. It is possible by means of specifications to secure a casing of certain weight and material, and assure satisfactory construction at the well top to eliminate surface contamination. However, these precautions are of small avail if the casing is not set sufficiently deep and tightly sealed so as to shut out the contaminated water following solution channels in the subsurface limestone.

Specifications covering these particular features of well construction have not alone been found entirely satisfactory for several reasons. First, it is not safe or economical to specify one certain depth for casings to apply under all conditions. Second, this part of well construction is not subject to inspection after completion and it is extremely difficult, if not impossible, to gain information after the well is completed. Third, presupposing a desire on the part of those concerned to carry out the intent of the specifications, their adequate interpretation under varying geological conditions requires a specialized technical knowledge of geology not possessed by the average engineer or well driller. Consequently, it has proved impossible in many instances for the State Board of Health to have adequate assurance of satisfactory well construction through the agency of specifications alone.

To overcome this difficulty in the sanitary construction of well water supplies a co-operative agreement was entered into between the state board of health and the state geologist that has proved most successful.

Specifications have been prepared covering the sanitary features of wells drilled in rock and the installation of well pumping machinery. All engineers are required to include these in specifications for the construction of municipal water supplies secured from wells.

In accordance with an agreement, the state geologist is informed concerning a proposed well water supply and the driller is required to send a written notice to that office at least one week before operation is started. This gives the state geologist an opportunity to advise with the driller concerning the probable conditions to be encountered and also to supply a set of sacks for drillings and a drill record book. After drilling operations are begun the driller is required to secure cuttings from every screw, place them in sacks, label and send them at once to the state geologist. Also, all information concerning openings, fissures or soft or broken ground encountered is reported. From these data the state gelogist determines the depth at which it will be necessary to place the casing in order to exclude water of recent surface origin following solution channels and fissures in the rock. When the proper depth for setting the casing has been reached a representative of the state geologist inspects the job, supervises the sealing of the casing and checks the tightness of seal, as required by the specification. After completion of the well all samples of cuttings secured after casing and the complete log are forwarded to the state geologist, who correlates these and

furnishes the owner and the state board of health with a copy of the completed log of the well.

Upon completion of the entire job, including installation of the pump, etc., a final inspection is made by an engineer from the state board of health to check for approval the sanitary features of the well top construction, including the proper drainage of the pit, if a pit is provided for, height of well casing above pit or pump room floor, well casing material, and the effectiveness of the seal between the drop pipe and casing. At this inspection samples are collected for bacterial analyses at the state board of health laboratory and for complete chemical analysis by the state geologist.

* * *

Duplex Concrete Filter Manifold

By F. B. Leopold
Contracting Engineer, Pittsburgh, Pa.

While the general features of mechanical filters that are essential to efficient results and economical operation are now fairly well established there still remains room for improvement in details of design, especially in the manifold system for distributing the wash water and gathering the filtered water.

It is the writer's experience that the beds of the average filter plant will be rebuilt on an average of once every four or five years. This would be unnecessary were there no disturbance of the fine gravel which is the final support of the sand bed and which prevents sand from drifting down into the manifolds. About two years ago the author settled upon a design which he believed would eliminate these difficulties. An opportunity to try the design presented itself about a year and a half ago when a plant built by the Pennsylvania Water Co., in Pittsburgh, some 16 years previously developed difficulty in its lateral pipe system which necessitated replacement.

Several beds have been fitted with the author's double system of distribution and it is expected that in time all will be. The primary bottom in this system corresponds to the ordinary manifold header and laterals. It has the same relative area of nozzle openings and may be precast, as they were in this instance, or may be built in the filter box, which requires no change from standard design.

The header is composed of a concrete conduit, the laterals facing it on either side. The open top of the conduit is then closed with a cover plate, the top of which is level with the top of the laterals and fastened down with anchor bolts, which are grouted in place. In the openings on top of these laterals are set heavy glass nipples of tough glass which form the distributing orifice.

On top of the primary system is a secondary system of 1x2-ft. interlocking hollow blocks, closed on one end, and corrugated on top. These blocks are perforated with holes 1¼-in. c. to c. with an area designed to reduce the velocity of the water of the primary system to about one-fifth, it being believed that with that reduction there could be no possible disturbance of the small gravel used to support the sand. The enclosed space in the secondary blocks prevents the water discharging into any one section from rushing to some other section of the bed where there may be less resistance, as where a heavy gravel bed is used.

The gravel bed used in this system is so thin (3 in.) and the particles so small (¼ to $\frac{5}{16}$ in.) that the opportunity for the water discharged from one section to rush to a distant point is reduced to a minimum, and if the flow can be controlled in a vertical direction until it reaches the sand bed, it will of necessity float the sand and prevent the growth of hard spots.

In addition to the advantage of distribution in washing, which should prevent the necessity of rebuilding the bed at intervals, this bottom system eliminates metal which will need replacement in the course of time, due to corrosion.

Besides the installation made at Pittsburgh, bottoms are being installed at South Haven, Mich., South Pittsburg, Tenn., Marianna, Ark., Apollo, Pa., Henderson, N. C., and Iowa City, Iowa.

Discussion: In answer to questions, Mr. Leopold said that the system is patented; will cost perhaps 20 per cent more than the cast-iron pipe type; and that the openings in the upper blocks increase in diameter downward from ¼ to ½ in., so if any sand gets into them it will drop and be caught by the glass nipples, so it could be hosed out.

As to frequency of sand renewal in filter beds various instances were cited by Mr. Leopold and others of from 1 to 5 hours. R. S. Weston, consulting engineer, Boston, and F. W. Green, superintendent of filtration, Passaic Consolidated Water Co., Little Falls, N. J., spoke approvingly of this type of filter bottom.

* * *

Water Aeration in Texas

By W. S. Mahlie
Chemist in Charge, Water and Sewage Purification, Fort Worth, Texas

A questionnaire was sent out to 54 water-works superintendents in Texas, of which 30 replied. Of these 30 replies, 15 represent well supplies, 14 surface waters, and one a mixture of both. Of the 15 well supplies representing a population of 679,800, 12 report no taste or odor troubles; one supply, serving 3,200, has trouble with hydrogen sulphide; another supply, representing 10,000, has iron trouble, and a third, Houston, reports occasional tastes attributed to iron bacteria. Aeration is resorted to in the treatment of the hydrogen sulphide and iron containing waters. Of the 14 surface supplies, representing a population of 791,000, only one supply caring for 45,000 people reports freedom from taste and odors, while all the others report trouble coincident with hot weather or low water. The tastes are always reported as coming from algæ. Of these 14 surface supplies, 8, representing a population of 597,000, report aeration in some form, 2 using spray nozzles, 5 using riser pipes and cascades, and one forcing air into the water by means of a paddle wheel. In all instances an improvement in taste and odor is indicated.

The Treasury Standard requires no odor of hydrogen sulphide, chlorine or other substances; freedom from odors caused by the presence of microscopic organisms; "iron as Fe should not exceed 0.3 p.p.m. If these requirements are to be met there is no doubt that there will be a great many aerator installations in the future. As soon as the public recognizes that tastes and odors can be eliminated, or at least reduced by some method they will demand it.

The use of pre-chlorination or super-chlorination followed by aeration offers a great field of possibilities.

[The foregoing paragraphs are from a long paper in which aeration for a variety of specific purposes is reviewed, with references to 31 earlier papers of which 16 cite articles in *Engineering News-Record* and its two predecessors.—Editor.]

* * *

Boiler Feed Water Studies

(Synopsis)

Two full sessions on this topic were under the direction of Sheppard T. Powell, chairman of the Committee on Boiler Feed Water Studies. The activities of this committee during the past two years were given in the form of a progress report, as were those of a Subcommittee on Priming and Foaming. Suggestions were made that a 5-yr. program of study be carried out by using university laboratories, now equipped to make studies and experiments. The Bureau of Mines, through Dr. Hall, has also offered the use of its facilities at Pittsburgh for this work. Attempts are being made to create a fund to cover research work on foaming, corrosion and pitting of boilers, in which the A.W.W.A. will join with the A.R.E.A., the A.S.T.M., and A.S.M.E., and several railroads and industries. That the railroads are vitally interested in these studies is shown by the number of railroad men in attendance. Several papers were given by railway water service engineers. E. M. Grime, of the Northern Pacific Railway, showed the effect of water on railroad efficiency, while J. E. Raps of the Illinois Central Railway gave cost data showing that his company, by spending 10c. per 1,000 gal. in treating over two billion gallons of water during the year, had effected a saving of $360,000 in replacement and fuel costs.

* * *

[*Additional abstracts of papers presented at the water-works convention will be published next week.*—Editor.]

Sinking Building Underpinned by Unusual Procedure

Concrete Warehouse on Piles in Deep Silt Settles Progressively—New Caisson Foundations in Alternate Bays

By Lt. E. D. Graffin (C.E.C.) U.S.N.
Public Works Officer, Marine Barracks, Quantico, Va.

SERIOUS settlement and cracking of a reinforced-concrete building at the Naval Aircraft factory, Philadelphia Navy Yard, developed during and after construction of the building in 1918, because of inadequate pile foundations, and ultimately led to an interesting repair job, by the construction of a new foundation. Design and methods of execution were unusual.

The structure is six stories high, 180x200 ft., of flat-slab type, with columns spaced 20 ft. both ways, and with brick exterior walls. It is supported by clusters of Raymond concrete piles under the column footings. Cramp & Co. were the contractors, and completed the building on Sept. 30, 1918, at a cost of $525,000. The soil on which the structure is built is silt to a depth of 50 to 60 ft., overlying sand and gravel, but the foundation piles are only 30 ft. long, being the longest available of the type adopted. Originally it was intended to load the piles to 30 tons each, but the loading was reduced by increasing their number when it turned out that many of the piles did not develop sufficient resistance in driving.

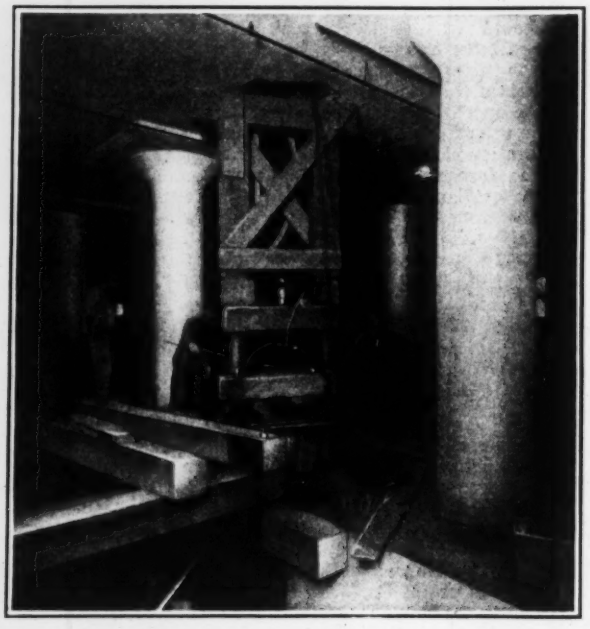


FIG. 1—CAISSON SINKING: JACKING RIG

As early as June, 1918, one pier loaded to its full design load settled 3 in. in 45 days. A few months after completion of the structure a crack appeared all around the building in the outer bay, at the edge of the column capitals. By January, 1919, the settlement of the building ranged from 6 to 16 in., and three years later, when underpinning was finally undertaken, it amounted to 12 to 24 in., being greatest in the southerly part, where the silt was deepest.

Choice of Method—The first plan for underpinning contemplated sinking steel pipe piles between the pier footings; jacking them down in successive short sections against girders attached to the footings; cleaning them out and filling them with concrete, and finally capping them with girders passing under the edges of the adjacent column footings and thus taking the load of these footings. Trials were made with 14-in. steel casings, jacked down in 2-ft. sections, but these either buckled or ran off plumb a sufficient amount to show that larger and heavier pipes would be needed. The call for bids on the underpinning therefore specified 15-in. heavyweight piles. One of the bidders, however, submitted an alternate design in which pneumatic caissons were to be sunk between the piers, and a gridiron system of concrete distributing girders was to be built on these caissons to carry the column loads. At this time (March, 1919) the entire project was deferred. At a second bidding, three years later, when the pipe pile method was again specified, an alternate bid on a caisson method of underpinning again was received, and upon careful examination it was accepted as preferable. Under this bid the work was carried out by the Triest Contracting Corporation, of New York.

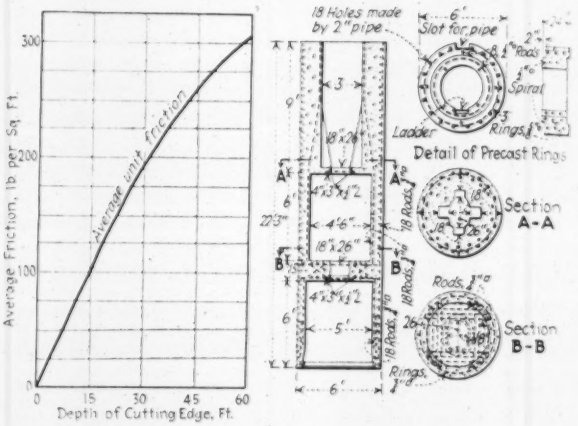


FIG. 2—SPECIAL CAISSON, PRECAST EXTENSION RINGS, AND DIAGRAM OF SKIN FRICTION DEVELOPED IN SINKING

Fig. 3 sketches the arrangement of the caisson-and-girder system. It will be seen that each caisson supports two columns, by means of a heavy double reinforced-concrete girder centered on the caisson and supporting the two adjacent column footings. The total dead- and live-load at the base of a 60-ft. caisson amounts to 800 tons; by belling the caisson to 10-ft. diameter at the bottom, the loading on the gravel subsoil was kept down to 10 tons per square foot, without crediting any supporting value to the old piles under the footings.

In order to avoid disturbing the building further, the work was so arranged that no two adjacent caissons were sunk at the same time. This plan was carried out strictly, and in conjunction with heavy shoring and timber trussing of the columns in the lower story it prevented any noticeable subsidence from the caisson sinking.

Because of the small space between the column footings and the restricted clearance available under the second floor, the caisson diameter and working height were limited, and the operations were badly cramped.

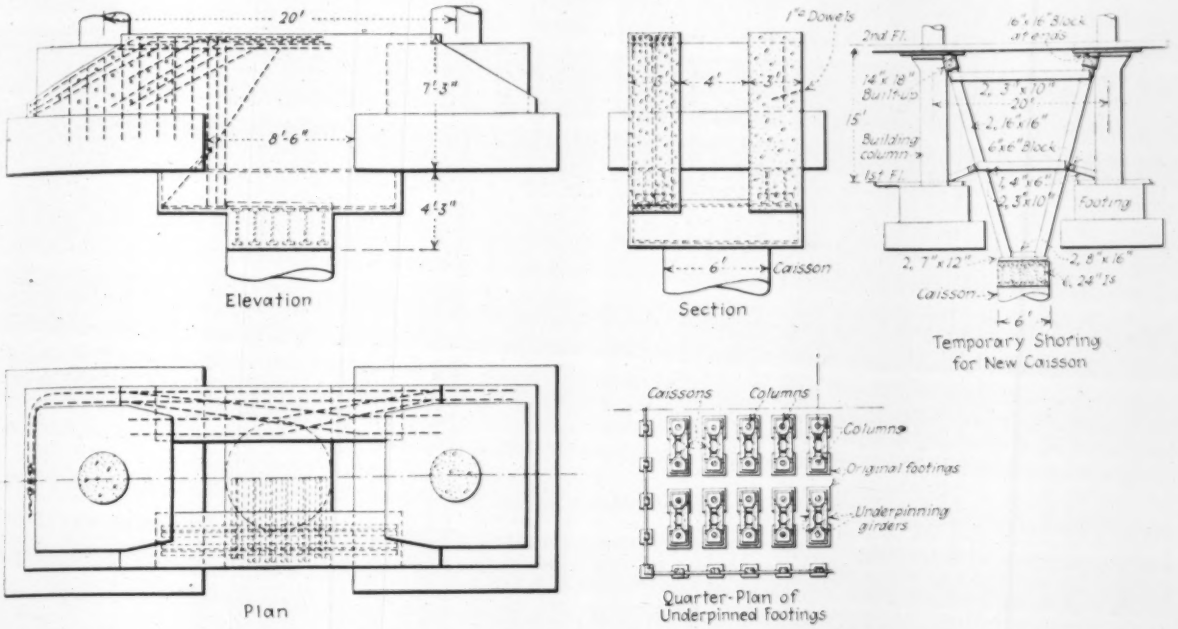


FIG. 3—CAISSON AND GIRDER SYSTEM OF NEW FOUNDATION, NAVAL AIRCRAFT STOREHOUSE, PHILADELPHIA

The caisson construction adopted is shown in Fig. 2. About 22 ft. of height could be constructed as the first build-up. The air lock was formed in the caisson directly over the working chamber. Additional lengths of caisson were placed in 10 to 12-ft. build-ups.

To facilitate the building up, the design contemplated using precast rings 22 in. high, weighing about 3 tons each, tied to each other and to the monolithic lower section of the caisson by vertical rods passing through holes poured in the concrete of the rings. Eleven caissons were constructed with the use of these rings, but their handling and placing proved so difficult that the other 25 caissons had their second and third build-ups cast in place, and rings were used only to bring the top to the desired elevation, where necessary.

Jacking was necessary frequently to sink the caissons. Screw jacks were first used, but were later replaced by hydraulic jacks of 100 tons capacity, bearing against heavy timber trussing built between the column footings and their caps at the second floor level. This trussing distributed the jacking load and also guarded individual columns against local settlement.

Spoil was hoisted out of the caissons through holes cut in the second floor directly over the caissons, and was carted away on this floor. Concrete was also poured from this floor, being supplied by elevator from a mixer outside the building.

Aside from the difficulties due to limited headroom and the necessity of jacking to make up for the limited weight of caisson available, the sinking progressed without incident. Observations of caisson weights and jacking pressure led to deductions as to average unit friction experienced by the caissons in the silt which are summarized in the curve included in Fig. 2. The maximum friction as the caissons reached full depth was about 300 lb. per square foot of peripheral area. Generally, the caissons were stopped at depths a little over 50 ft. and the bell excavation (to 10-ft. diameter) was carried on below the cutting edge, the air pressure (about 20 lb.) being sufficient to keep the bottom dry and to hold up the sides of the bell.

In sealing the working chamber, concrete was discharged into the lock and locked through in bulk. This process was continued until the concrete had been car-

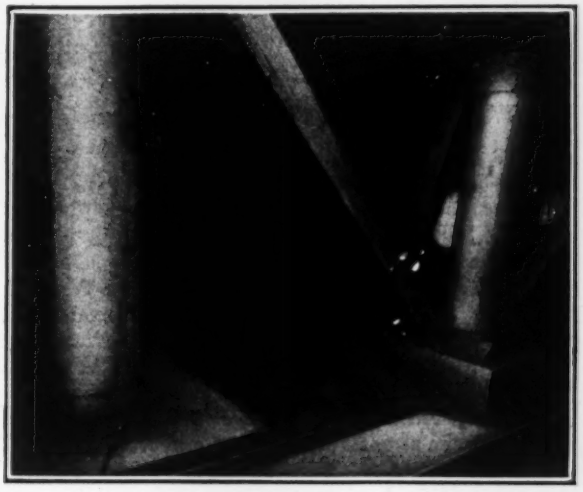


FIG. 4—GIRDER REINFORCEMENT READY FOR CONCRETING

ried up to within 2½ ft. of the roof of the working chamber, after which the concrete was given 24 hr. to to set under air pressure, the air was taken off, the lock doors removed, and the remainder of the working chamber and shafts filled to within 4 ft. of the bottom of the adjacent column footings. The chamber filling was of 1:2:4 mixture, and the shaft filling of 1:3½:7 mixture. Grillage and needle beams of 24-in. I-beams as indicated in Fig. 3 were placed on the caisson after cutting it (if necessary) to the required level, and the beams encased in concrete. The final operation was to construct the double reinforced-concrete girder extending over and around the adjacent column footings to hold them in position and assist in transferring their load to the caissons. As soon as the lower tier of grillage beams was placed, two 16x16-in. douglas fir shores

were set between the top of the grillage and the column capitals, and were left in place during the concreting of the needle beams and the construction of the reinforced-concrete tie girders, and for 30 days thereafter, to prevent any disturbance in relative position of column footings and caissons during the setting.

Actual sinking of the 36 caissons started Oct. 30, 1922, and was completed in 78 days, or by Jan. 15, 1923. During this time an average of 29 cu.yd. of caisson excavation per day was taken out and a slightly smaller quantity of concrete was poured.

Settlement readings taken during the entire time of the work showed a general behavior of the building similar to that during the preceding three years. One month after the pouring of the last beam, however, settlement had come to a practical stop.

The pneumatic caisson work was carried out by P. J. Gray, of New York. T. K. Thomson acted as consulting engineer for the contractor, the Triest Contracting Corporation.

The original building was built under the direction of Rear-Adm. C. W. Parks, chief, Bureau of Yards & Docks, U. S. Navy. At the time the building was underpinned, Rear-Adm. L. E. Gregory was chief of the bureau. The work was carried out under the direct supervision of the public works officer of the Fourth Naval District, Rear-Adm. F. R. Harris. The writer was in immediate charge of the work.

Asphalt Replaces Water Binding on Arid Road Work

Long Water Haul Made Cost of Asphalt Penetration Less on Sledge Stone and Macadam Base Than Water Binding

By L. R. Allison,
Resident Engineer, State Highway Department, Breckenridge, Texas

TWO state roads of Breckenbridge in the Texas oil country and therefore heavily traveled roads were effectually improved last summer at no excess cost by changing a waterbound to an asphalt penetration base. The roads aggregated 35 miles and for base the original plans called for 50 cu.yd. of sledged stone of 6-in. maximum size, and 25 cu.yd. of crushed stone to the station on an 18-ft. road. The sledged stone was placed and thoroughly rolled as planned. The voids in this stone were filled with No. 2 stone and screenings and the surface was wet and rolled as in ordinary waterbound macadam. When this was thoroughly set up, it was planned to place the asphaltic concrete surface directly on this base.

It is customary in Texas to let contracts for macadam base, paying unit prices per 1,000 gal. of water and overhaul, and per hour of rolling. These roads pass through a sparsely watered country, necessitating long hauls of water. The stone used in the base is a very hard limestone that requires a great deal of water and long rolling to set it up, and ravels very readily when dry. It soon became evident in construction that this base was going to be rather expensive and not very satisfactory. In addition to the expense involved it became evident that a satisfactory base could not be obtained by water binding the material available.

After about 4½ miles of base had been completed as contemplated by the plans and specification, the writer, in charge of the work for the state highway department, determined to devise some method to secure a more satisfactory and less expensive job. Several experiments were made and as a result it was finally determined that it would cost no more and that a much better base would be obtained if it were treated with asphalt instead of attempting to water-bind it. The necessary field changes in the plans were made and the remainder of the base was treated with Texaco No. 130 Asphalt, a rather soft asphalt with a penetration of 120 to 150 at 77 deg. F. and a melting point of 105 deg. to 120 deg. F.

The method of construction was as follows: The sledged stone was placed and thoroughly rolled as before. The screenings were applied and dry rolled till the voids were completely filled. No. 2 stone was added, spread and rolled until it was thoroughly keyed and presented a smooth uniform surface. This surface was then treated with the above mentioned asphalt, using 0.6 gal. per square yard. The surface was then covered with screenings using 2½ cu.yd. per station, or just enough so that the asphalt would not pick up under traffic or stick to the roller. The surface was again rolled and was ready to receive the wearing surface. The resulting base is about 9 in. in thickness with all voids completely filled.

No further difficulty has been encountered with the base. It is opened to traffic immediately after being treated with asphalt, and in some cases has been subjected to heavy truck traffic for several months without deteriorating, before the wearing surface has been laid. The wearing surface consists of 2 in. of ordinary asphaltic concrete, laid with hard native limestone, dust, and Texaco No. 54 paving cement. Where samples have been cut from the finished pavement, it is shown that the asphalt has penetrated the base to a depth of 1½ to 2 in. and the surface adheres so firmly to the base that it is impossible to cut out a sample of surface without the base coming out to the depth to which the asphalt has penetrated. Tests have shown that the asphalt penetrates farther into the base after the asphaltic concrete surface is applied than it does when first applied by the distributor. This is true even after several months have elapsed before the surface is applied. After the construction of one project it was decided that 0.76 gal. of asphalt will give better results and will justify the slightly increased cost.

Another novel feature of this job is that the asphalt plant is out on the road, five miles from the railroad. The plant is located at the stone quarry where all of the materials but asphalt are within very short haul. The asphalt is received in tank cars and hauled to the plant in tank trucks. Storage in a tank with steam coils is maintained at the plant. The maximum haul from the plant to the end of the road is about 15 miles. Surface mixture is hauled in high-speed trucks which make the trip from the plant to the end of the road in about 20 minutes.

Both base and surface are being constructed by L. W. Pelphrey & Co. of Breckenbridge, Texas.

Railway Builds Long Water Supply Line

A railway pipe line 9,000 ft. long, of 3-in. cast-iron pipe, was laid in 1926 by the Colorado & Southern Ry. from Guiterrez Springs to Nola, N.M., to supply water for the locomotives. The cost was about $17,200.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Present-Day Knowledge of Fatigue

THE FATIGUE OF METALS: With Chapters on the Fatigue of Wood and of Concrete—By H. F. Moore, Research Professor of Engineering Materials, University of Illinois, M.A.S.T.M., In charge, Joint Investigation of the Fatigue of Metals; and J. B. Kommers, Associate Professor of Mechanics, University of Wisconsin, M.A.S.T.M., Formerly Engineer of Tests, Joint Investigation of the Fatigue of Metals. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 326; 102 halftones and line cuts, 24 tables. $4.

A general account of present knowledge of the endurance of metals to repeated stressing is given in "The Fatigue of Metals" by two investigators whose contributions to this fascinating subject of inquiry rank them as prime authorities. What they have written is scholarly, precise, and so judicial in its analyses and comparisons of the scattered mass of experimental results as to make it a fundamental scientific and technical monograph.

In one detail the authors place an obstacle in the way of the reader's readiest absorption of the picturesque mass of facts which they present. They precede their statement of observed and experimentally studied facts by three or four preparatory chapters, dealing with stress and strain in metals, early endurance investigations, and speculation concerning such phenomena as overstrain, hysteresis, and the nature of repeated stress failure. An easier introduction to the subject may be had by skipping these preliminary discussions and, after a glance at the chapter on testing machines and specimens, taking up at once the results of modern fatigue tests.

Three chapters contain the meat of the book, so far as endurance of metals is concerned, under the respective titles of "Results of Fatigue Tests," "Effect of Range of Stress," and "Effect of Stress Raisers." Two other chapters summarize (in much briefer form, but again with patient and judicial analysis of the findings of the principal investigators) what is known of the endurance of wood and of cement and concrete. Even though one may be interested primarily or solely in metals, he should, by all means, read these chapters because of the intimate analogy between endurance phenomena in the realm of three totally different kinds of material. Finally, the reader may turn back to the philosophical, speculative and discursive chapters with which the book opens.

The treatise is quite inclusive. It does not omit mention and discussion of the curious fact of combined corrosion and fatigue—as yet only partly explored—nor the still more curious observation that some materials may be strengthened against fatigue by preliminary repeated stressing below the original endurance limit (which has been aptly called "coaxing"). Not only are these subjects interesting and important in themselves, but they probably have a vital relation to the ultimate explanation or understanding of fatigue rupture, since at present they appear to be among the major question marks in the entire field. One might wish that the authors had gone more fully into the subject of coaxing, both on the score of practical importance and because it may have a close relation to the mechanism of fatigue.

While the subject of endurance study will doubtless continue to advance as rapidly within the next few years as it has in the past six or eight, the present work is certain to remain of value for a long time. It rests on so large an amount of study and personal intimate testing-room knowledge of the subject that it cannot fail to be a sound guide even after much further research fact has been added to our knowledge. As bearing on the vitality of the book, it may also be noted that the manuscript was read by D. J. McAdam, Jr., one of the most originally minded delvers into the mysteries of fatigue and one whose work has supplemented most interestingly the Illinois investigations directed by Professor Moore.

Planning and Replanning Small Towns

NEW TOWNS FOR OLD: Achievements in Civic Improvement in Some American Towns and Neighborhoods—By John Nolen. Introduction by Albert Shaw. Boston, Mass.: Marshall Jones Co. Cloth; 6 x 8 in.; pp. 177; 79 halftone plates (not included in page numbering), 36 line drawings in text. $3.

Out of the abundance of his city planning experience, Mr. Nolen has written an interesting and suggestive little book on the improvement of existing small towns and the creation of new ones, the latter either as suburbs of large cities or as entirely new industrial or resort communities. The opening pages present briefly the movement toward smaller population centers. Among specific recent examples are the reshaping of Walpole, Mass., into an industrial town, the creation of the new industrial town of Kingsport, Tenn., and the building of Mariemont, Ohio, as an overflow and escape for dwellers in Cincinnati. The volume abounds with illustrations, of which the halftones are excellent but many of the town plans are of little use because not redrawn and relettered for reproduction—a need that many writers and publishers of books and periodicals on town planning sadly ignore. Appendices list numerous reports on the planning or replanning of towns and small cities and also books on town and city planning. The volume is a worthy addition to Mr. Nolen's long list of planning books and reports.

Supplying Fuel to the Railways

RAILWAY FUEL: The Coal Problem in its Relation to the Transportation and Use of Coal and Coal Substitutes by Steam Railroads—By Eugene McAuliffe, President, The Union Pacific Coal Co., and Washington Union Coal Co. New York and London: Simmons-Boardman Publishing Co. Cloth; 6 x 9 in.; p. 468; 86 line cuts and halftones; numerous tables. $5.

Civil engineers in railway service are directly concerned with fuel problems, principally those relating to coal, as they occur in storing the fuel and delivering it to the locomotives and power plants, and occasionally with those of transferring coal to and from ships, problems which are all those of mechanical handling. Indirectly, however, they have other interests in the subject which carry them farther afield, for upon the quality of the fuel used and the quantity consumed per ton of freight hauled depends, in a large part, that all important figure of cost per ton-mile.

On all these subjects Mr. McAuliffe is particularly well qualified to speak. Beginning his experience with railway fuel in that intimate contact which is the part

of all locomotive firemen, he advanced step by step to where he became a coal producer. From this experience he has written, dealing with coal and oil from a different viewpoint than that of most treatises on either subject, giving enough of the background in the matter of sources of supply and mining methods to provide his readers who are not mining men with a proper knowledge of these subjects. For the railroad man he discusses purchase and inspection, car distribution and storage of coal, use of oil and powder fuel, fuel conservation and performance, road losses, trends in locomotive design, water for locomotives, and the relation of coal to ton-miles. Others will find much of interest within the pages of the book.

Some German Books on Concrete

WASSERDURCHLASSIGKEIT VON BETON, in Abhängigkeit von seinem Aufbau und vom Druckgefalle—Von Dr.-Ing. Gustav Merkle. Berlin: Julius Springer. Paper; 6 x 9 in.; pp. 68; 33 halftones and line cuts. 5.1 reichsmarks, gold, in Germany.

BEWEGUNGSFUGEN IM BETON- UND EISENBETONBAU—Von Prof. Dr.-Ing. A. Kleinogel, Privatdozent a.d. Tech. Hochschule, Darmstadt. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 220; 540 halftones and line cuts.

DER AUFBAU DES MÖRTELS UND DES BETONS: Untersuchung uber die zweckmässige Zusammensetzung des Betons und des Zementmörtels im Beton. Hilfsmittel zur Vorausbestimmung der Festigkeitseigenschaften des Betons auf der Baustelle. Versuchsergebnisse und Erfahrungen aus der Materialprufungsanstalt an der Technischen Hochschule Stuttgart—Von Otta Graf. Berlin: Julius Springer. Paper; 6 x 9 in.; pp. 76; 60 halftones and line cuts. 7.2 reichsmarks, gold, in Germany.

DIE RATIONELLE BEWIRTSCHAFTUNG DES BETONS: Erfahrungen mit Gussbeton beim Bau der Nordkaje des Hafens II in Bremen—By Dr.-Ing. Arnold Agatz, Baurat in Bremen. Berlin: Julius Springer. Paper; 5 x 8 in.; pp. 124; 60 halftones and line cuts. 7.5 reichsmarks in Germany.

BETONZUSAMMENSETZUNG UND DRUCKFESTIGKEIT — By Dr.-Ing. Georg Eisfelder, Berlin. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 55; 17 line cuts. 5.40 reichmarks.

MITTEILUNGEN ÜBER VERSUCHE—Ausgeführt vom Österreichischen Eisenbeton-Ausschuss. Heft 11: VERSUCHE MIT SAULEN AUS UMSCHNÜRTEM BETON UND AUS UMSCHNURTEM GUSSEISEN—Bericht, Erstattet von Dr. Fritz Emperger, Dr. techn. e.h. (mit 40 abbildungen und 6 tabellen); und SETZPROBE UND FLUSSIGKETTSGRAD VON BETON, VERGLEICH VERSCHIEDENER PROBEKORP ERFORMEN, Bericht, Erstattet von Dr. Franz Rinagl, a.o. Professor an der Technischen Hochschule in Wien (mit 11 abbildungen und 2 zahlentafeln). Leipzig und Wein: Franz Deuticke. Paper; 6 x 9 in.; pp. 110; illustrations and tables as noted above. 5 reichsmarks in Germany.

DURCHLAUFENDER EISENBETONKONSTRUKTIONEN ELASTISCHER VERBINDUNG MIT DEN ZWISCHENSTÜTZEN (Plattebbalkendecken und Pilzdecken)—Von Baurat Dr.-Ing. F. Kann, Wismar. Berlin: Julius Springer. Paper; 6 x 10 in.; pp. 72; 47 line drawings, many tables.

A large number of recent German monographs dealing with one or another phase of concrete production or use, testifies to the close attention being given this important subject in Europe at present. A few recent books and pamphlets are noted. Concrete mixture design and control are specially popular.

In "Wasserdurchlässigkeit" the author reports some tests which lead him to conclude that permeability depends mainly on the water-cement ratio, just as does strength, the permeability increasing as the water ratio increases. Maximum density of fine aggregate also helps to make concrete tight, in other words the sand should be well graded; but excess of sand is not of advantage. Prevention of shrinkage by sufficient water supply during curing is important.

Dr. A. Kleinogel, in "Bewegungsfugen," presents an extensive album of designs of expansion joints for concrete structures, classified according to type of structure. The drawings are clear and the description and discussion appear adequate.

O. Graf brings out a second edition of a monograph first published five years ago dealing with the make-up of cement-mortar and concrete. Water-cement ratio and influence of the mechanical analysis of the sand are particularly discussed.

A seawall at Bremen, nearly a mile long and containing nearly 45,000 cu.yd. of concrete, was built two years ago, with deposition by chutes and pipes. Mixture tests and other features of the wet concrete used are discussed in a short pamphlet by A. Agatz. One of his findings is that the slump test is not of value, as it is applicable only between 13 and 16 per cent of water and may prove misleading, as it ignores a number of factors of consistency.

Concrete mixtures are also discussed in the monograph of Dr. Eisfelder, who concludes that the variation of strength of concrete with water-cement ratio is a useful relation, but holds only approximately. Problems in the field application of mixture control are discussed also.

Further studies of slump-test control are reported by Rinagl, whose results point to the importance of selecting an aggregate that will make the most workable concrete with the minimum water admixture.

In the same booklet, Emperger reports on some tests of hooped concrete columns with cast-iron core.

In a slightly different field is the booklet of Kann, who gives diagrams and tables for moments and reactions in continuous floors of both ribbed and flat slab construction.

Administration of the Panama Canal

THE PANAMA CANAL: Its History, Activities and Organization—By Darrell Hevenor Smith. [Institute for Government Research, Service Monographs of the United States Government, No. 44.] Baltimore, Md.: The Johns Hopkins Press. Cloth; 6x9 in.; pp. 413. $2.50.

The title of this monograph, "The Panama Canal," is somewhat misleading. The book is not, as the title would indicate, a history of the Panama Canal, but rather a study of the organization charged with the operation of the canal and the administration of the Canal Zone, an administrative establishment officially known as "The Panama Canal," whose history begins, strictly speaking, on April 1, 1914, when the provisions of the Panama Canal Act of 1912 were put into effect. The book is a very complete record of that organization and its activities and of the laws relating to it, the composition of its staff, and the numerous functions which make it one of the most important departments of the federal government.

Aspects of Quantity Surveying

PROCEEDINGS OF INITIAL AND ORGANIZATION SESSION OF THE AMERICAN INSTITUTE OF QUANTITY SURVEYORS, 1926—Chicago: C. T. Burman, Secretary, American Institute of Quantity Surveyors (500 North Dearborn St.) Cloth; 6 x 8 in.; pp. 227. $2.50.

With the increasing employment of quantity surveyors by architects, engineers and contractors in taking out quantities and preparing estimates for construction work, it is of interest to note the varied experiences and ideas presented at the Chicago meeting which led to the organizing of this new technical association. The book consists mainly of discussions on several set subjects, with no extended individual papers, but these prolonged discussions are of particular interest in recording the opinions, practice and experience of a number of men engaged in this class of engineering work. They also illustrate the development of quantity surveying in this country, which is of very recent date.

Taking the Guess Out of Land Valuation

THE SCIENCE AND PRACTICE OF URBAN LAND VALUATION: An Exposition of the Somers Unit System—By Walter William Pollock, President, The Manufacturers' Appraisal Co., and Karl W. Scholz, Ph.D., Assistant Professor of Economics, University of Pennsylvania. Philadelphia: The Manufacturers' Appraisal Co. Cloth; 6 x 9 in.; pp. 315; numerous line cuts. $5 net; 21 sh. in England.

The crude way in which land is assessed for taxation in most of our cities is one of the greatest blots on municipal administration. Fortunately scientific method has already replaced guesswork, thumb rules and favoritism in many cities, with good prospect of widespread adoption. Although the book mentioned above is designed primarily to describe, and at least secondarily to promote, the use of a particular method of land valuation it is based on fundamental principles the exposition of which is useful to any assessor or engineer concerned with such work.

The book opens with a well-handled outline of the principles of land valuation. Then comes a long section on valuation practice in which there are first considered ways and means of arousing local interest in proper methods of valuation and of getting a general agreement on the part of realtors, business men and citizens generally as to relative land values in different locations, thus leading up to block valuation maps for the entire city, absolutely independent of lots or ownership. These block values are expressed in terms of front feet one foot deep for each side of the block. This accomplished, lot valuation becomes a matter of applying fixed rules by means of tables and curves to take account of lot depths, corner lots, overlapping and other influences. Some consideration is given to the valuation of buildings, but chiefly as to general principles. The body of the book concludes with several chapters on the significance of scientific land valuation. Appendices contain illustrative tables.

The book should be in every tax assessor's office. It will be useful to the many engineers concerned more or less closely with land valuation for taxation, benefit assessments, condemnation, or for business and manufacturing purposes. It deserves the attention of hosts of others interested in sound municipal administration and a fair distribution of tax burdens.

Municipal Procedure

PRACTICE OF MUNICIPAL ADMINISTRATION—By Lent D. Upson, Director of Detroit Bureau of Governmental Research. [The Century Political Science Series.] New York and London: The Century Co. Cloth; 6x9 in.; pp. 588. $4.

Municipal procedure rather than the theory of municipal government and analysis of city charters is the subject of this well-written volume. "The discussion is intended," the author states in his Foreword, "not for the professional administrator . . . but for the lay citizen, in or out of public office, who wishes some acquaintance with the problems that perplex the professional."

Consideration is first given to administrative organization, elections, and civil service. Various financial matters are covered under the heads of budgets, revenues, debt, treasury and accounting. There is a separate chapter on central purchasing and another on motor transportation. The various municipal departments are then taken up, including the whole range of engineering work. There is a separate chapter on engineering in general and other chapters on pavements, wastes, sewerage, water, and lighting. The concluding chapters deal with the control of utilities and with municipal ownership.

A footnote on the first page for each chapter makes acknowledgement to main sources. These and other footnotes, as well as the text, indicate that the book consists largely of abstracts of monographs and special reports and articles. The author presents a long list of collaborators in the writing and revision of the book.

Some of the condensation of material found in authoritative engineering books gives indication of lack of perfect understanding on the part of the abstractor which was not rectified by the collaborators to whom the author gives credit. These minor weaknesses are not likely to lead astray many of the class of readers for whom the book is intended, and for whom, on the whole, it will serve admirably. The chief cause for regret is that so few of the many who would profit by reading the book will ever see it, there being no law to compel uninformed city officials to post themselves as to the best methods of performing their duties and meeting their obligations to the people whom they are supposed to serve.

Steel in Architectural Construction

ARCHITECTURAL CONSTRUCTION, Vol. II: AN ANALYSIS OF THE STRUCTURAL DESIGN OF AMERICAN BUILDINGS, Book Two: STEEL CONSTRUCTION—By Walter C. Voss, S.B., Consulting Engineer, Boston, Mass., Formerly Head of Department of Architectural Construction, Wentworth Institute, Boston, Mass.; and Edward A. Varney, S.B., Structural Engineer, Cambridge, Mass., Formerly Instructor of Mechanics and Structural Design, Wentworth Institute, Boston, Mass. New York: John Wiley & Sons, Inc.; London: Chapman and Hall, Ltd. Cloth; 9x12 in.; pp. 564; 609 halftones and line cuts. $10.

Following the treatment of wood construction in buildings, with which the first book of Voss & Varney's work was concerned (reviewed in *Engineering News-Record*, Aug. 19, 1926, p. 311), steel construction is taken up in the secnd book, just issued. The authors have performed a workmanlike task in the preparation of the volume. They cover the structural part of building work—walls, floors, roofs, and the steel framework itself—soundly and in considerable detail. It does not appear that they have gone outside the conventional in their treatment or that they add anything to the subject, essentially their offering is to be regarded as a new compilation of practice rules in this field, amply illustrated, but without innovations or any element of special stimulus.

Their treatment—we repeat that it is profusely illustrated—begins with the analysis and the detailed design of beams and girders, covering about 100 pp., standard but well written, except that the potentially revolutionary new beam series of the Carnegie Steel Co. is not mentioned. Floor and roof construction is next taken up, dealing with both the slab or arch element and the framing. Roofing itself and floor surfacing are not considered, however. There follows a chapter on column design, and finally, under the title "Miscellaneous Framing," a discussion (among other things) of the general assemblage of building frames with respect to that crucial element of high building construction, the wind-bracing. The position of this important subject is rather subordinate, as it is sandwiched in between stair framing and elevator framing. The last section of the book deals briefly with mill buildings.

As a whole, the book will add to the architect's library in a valuable way, as it will make available to

him a sound and fairly thorough guide book of counsel and reference in any questions relating to the steel framing of his structures. Probably it will prove less valuable to the structural engineer, who has similar material available in other books written more directly for his use, as well as in the smaller format that is better suited to the engineer's designing table.

History of the 11th Engineers

HISTORY OF THE ELEVENTH ENGINEERS—By V. T. Boughton, Assistant Editor, *Engineering News-Record*, formerly Adjutant, 11th Engineers, U. S. Army. New York: Trustees Eleventh Engineers Fund, 84 Pine St. Cloth; 6x9 in.; pp. 540; 265 halftones and line cuts, 7 plates. $3 to limited sale outside of regiment.

The History of the 11th Engineers has been written chiefly to provide a permanent record of the unit's participation in the World War for those men who served in the unit. As such, it has been printed in a limited edition. However, as the history of any regiment with two years of active service to its credit, including nearly a year of service with the British Army, is certain to be of interest to other than those who served with it, a few additional copies have been printed for public libraries and those especially interested in military engineering. This notice is published not only for the advice of such persons, but also in an effort to reach many of the engineers who served with the regiment whose addresses are unknown to the committee in charge of publications.

Publications Received

WATER-WORKS MEN will find useful a N.E.W.W. Assoc. reprint of a paper by H. W. Clark, chief chemist, Massachusetts State Board of Health (State House, Boston), on The Effect of Pipes of Different Metals Upon the Quality of Water Supplies.

THE SYSTEM OF STANDARD ROAD SIGNS AND MARKERS adopted by the American Association of State Highway Officials is described and illustrated in a Manual and Specifications for the Manufacture and Display and Erection of U. S. Standard Road Markers and Signs, issued from the association's office, Munsey Building, Washington, D. C. The manual contains specific diagrams for road intersections, railway crossings and other complicated situations.

AN ABUNDANCE of information on the main topic and allied matters is given in Facts and Figures of the Automobile Industry, 1927 (National Automobile Chamber of Commerce, 366 Madison Ave., New York City). Many diagrams and maps are included, besides state regulations, license charges, gasoline tax provisions, passenger and truck registration, and much other information.

THE LANDIS AWARD, Its Purpose and Accomplishments, is the title of a 45-p. pamphlet issued at Chicago by the Citizens Committee to Enforce the Landis Award. Its object is to explain the organization and successful work of this committee, organized to assist contractors and the public in resisting unreasonable conditions due to union control of the building industry. Illustrations show a number of large public and private buildings erected by Landis Award contractors.

PROTECTION FROM LOCOMOTIVE GASES, for structures over railway tracks, is one of the special subjects dealt with in the 1926 *Proceedings* of the American Railway Bridge and Building Association ($2 from the Sercetary, C. A. Lichty, 319 No. Waller Ave., Chicago). It is supplemented by reports on methods of painting steel and on the organization of railway painting forces. Other reports and discussions deal with railway pumping equipment; roofing materials; methods of repairing concrete; uses of creosoted timber, and the varied applications of compressed air in railway work.

THE STANDARDIZATION MOVEMENT throughout the world, with most attention naturally given to the United States, is outlined in Standard Year Book, 1927, compiled by the National Bureau of Standards ($1 from Superintendent of Documents, Washington, D. C.). This Year Book will be issued annually hereafter. According to the letter of submittal written by George K. Burgess, director, Bureau of Standards, to Secretary Hoover, the publication "contains outlines of the activities and accomplishments of not only this bureau and other agencies of the federal government and the states and municipalities, but also of the American societies and associations of which standardization is a major or very important activity . . . outlines are given of the various foreign, national, and several international standardizing agencies."

GREAT LAKES COMMERCE and the Port of Oswego, N. Y., is the subject of a report to the Harbor & Dock Commission at Oswego by Fay, Spofford & Thorndyke, consulting engineers, Boston. With the completion of the Welland canal, in 1930, Lake Erie will be open to deep-draft vessels of the upper lakes and the Port of Oswego, near the eastern end of Lake Erie, will acquire a strategic position in the lakes transportation system due to its being the Lake Erie terminal of the New York Barge Canal system and to its having three through railroad lines to the port of New York. For this reason, the Harbor and Dock Commission, in 1924, undertook to make a commodity survey of the Great Lakes region in order to determine what traffic would be diverted to Oswego and to develop a plan for handling the traffic. The report mentioned above is the result of that decision. It contains a comprehensive survey of commodities handled on the Great Lakes as well as detailed descriptions of the present transportation system and the various channels of commerce such as the New York Barge Canal, the Welland canal, and the St. Lawrence waterway. The report is in two volumes, Volume I, the report proper, and Volume II, the maps, tables and diagrams. ($10 from Harbor and Dock Commission, Oswego, N. Y.)

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

BLUE BOOK OF SOUTHERN PROGRESS: 1927. Baltimore, Md.: Manufacturers Record Publishing Co. Heavy paper; 6x9 in.; pp. 250 (251 to 366 advertisements).

THE ENGINEERING INDEX: 1926. New York: American Society of Mechanical Engineers. Cloth; 7x10 in.; pp. 809. $6 to members; $7 to non-members.

Continues along its well-known useful lines, covering articles on civil, mechanical and other branches of engineering and allied subjects in the American and foreign technical press.

INFORME SOBRE LOS HUMOS DE LA OROYA—Por Jose J. Bravo, Director del Cuerpo de Ingenieros de Minas y Aguas. (Boletin del Cuerpo de Ingenieros de Minas del Peru, No. 108; Ministerio de Fomento). Lima, Peru: Imprente Americana (Pzl. del Teatro). Paper; 7x10 in.; pp. 207; line drawings and tables.

JAHRBUCH DER ELEKTROTECHNIK, 1925: Übersicht über die Wichtigeren Erscheinungen auf dem Gesamt-Gebiete der Elektrotechnik, unter Mirtwirkung Zahlreicher Fachgenossen und mit besonderer Unterstutzung des Zentralverbandes der Deutschen Elektrotechnischen Industrie—Herausgegeben von Dr. Karl Strecker. Munchen und Berlin: R. Oldenbourg. Cloth; 7x10 in.; pp. 285; 9 line drawings. Cloth, 16 reichsmarks, in Germany.

AN OUTLINE OF CAREERS: A Practical Guide to Achievement, by Thirty-eight Eminent Americans—Edited by Edward L. Bernays, Author of "Crystallizing Public Opinion," etc. New York: George H. Doran Co. Cloth; 6x10 in.; pp. 431. $5.

PODRECZNIK INZYNIERSKI: W. Zakresie Inzynierji Ladowej I Wodnej—Redaktor naczelny, Prof. Dr. Inz. Stefan Bryla. Tom 1: Roboty Ziemne, Drogili Ulice—Koleje Zelazne Miernictwo-Budownictwo Wodne. Lwow I, Warszawa (Poland): Nakladem Ksiegarni Polskiej B. Polonieckiego. Cloth; 5x8 in.; 316 line cuts; many formulas and tables.

THE PREPARATION AND REVISION OF LOCAL BUILDING CODES—By George N. Thompson, Secretary, Building Code Committee, U. S. Department of Commerce. New York: Municipal Administration Service (261 Broadway). Paper; 7x10 in.; pp. 26. 25c.

Writing and revising building codes is so extensive a performance nowadays that George N. Thompson's monograph on the preparation of codes has both an educational and a service value. Many of the complexities of the subject are well brought out, and a large number of useful hints is given, including the plan of arranging a code as outlined by the Building Code Committee of the U. S. Department of Commerce.

ULTIMOS PROGRESOS EN LA CONSTRUCCIÓN DE PUENTES POR EL INGENIERO CIVIL: Por Lorenzo Perez Castro, Ex-Presidente de la Asociación de Ingenieros y Arquitectos de Mexico, Miembro de la Sociedad Americana de Ingenieros Civiles. Mexico City, Mexico: Ingenieria y Arquitectura, S. A. Paper; 6x9 in.; pp. 59; 10 halftones, 2 plates (Firth of Forth and Quebec bridges).

A well written, short essay on some features of modern bridge design is presented by Mr. Castro. Spanish-reading engineers will find the work gives a helpful and stimulative review of practice and tendencies.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Earthquakes and Building Codes

Sir—The editorial "Earthquakes and Building Codes" in your April 28 issue seems to me to suggest, by implication at least, that San Francisco designing engineers are unmindful of the earthquake hazard. I believe, on the contrary, that reputable engineers are using as much care in attempting to minimize earthquake damage as they have ever used during the last 25 years. It is true, of course, that we are not building earthquake-proof buildings any more than we are making them fireproof. It would not be practical to do so. Our designs, however, should minimize the hazard, and, in so far as may be, prevent the loss of life or limb and simplify the restoration of damaged structures to their original condition.

I do not believe in the use of a 30-lb. wind load in a country where the actual wind load is only 15 lb. The principal result is to increase unduly the cost of building. If the steel frame is honestly designed for the stresses of a 15-lb. wind and is otherwise in accord with the building law, the actual resistance is much more in most cases, due to partition and wall resistance. In any event, unless diagonal bracing is used, and this is generally impossible, the resistance of the steel frame will not be in evidence until the walls and partitions have sheared horizontally. This was confirmed by Miami observations.

The ordinary Class A business building is of a type well suited to withstand earthquakes with minimum damage. My point of view is one suggested in your editorial, and is not new. I advocated it after observation of the results of the 1906 earthquake, and I was further confirmed in this view by the results of the Santa Barbara earthquake. In brief it is this:

It is probable that in severe earthquakes well constructed reinforced-concrete or steel-frame buildings *with concrete walls* up to two or three stories in height and having not too much window and door space can be attached to and will move with the ground. Buildings of this type are well represented by the reinforced-concrete school buildings of San Francisco. Stores having mostly glass in the first story would not be of this type.

It is manifestly true that buildings of ten or more stories cannot possibly be constructed so as to move with the ground, and any attempt to construct them so will result in a whipping motion, causing disastrous racking vibration. There is evidently some height, however, to which a building can be economically built on any site so as to be expected to move with the vibrating earth. Just what height this is might be difficult to decide, but it is probably less than six stories, as the mass and weight increase with the height, and there is bound to be a critical point.

It is the duty of the engineer so to design a building as (1) to make it safe for human occupancy and (2) to minimize property damage in case of earthquake.

The ordinary steel-frame office building with stores on the first floor is well adapted to efficient bracing to secure the safety of the occupants and the minimum earthquake damage. From the second floor up the structure is of relatively low story heights and can be efficiently braced—by diagonal bracing when practical—to make a very rigid box of great weight and, in consequence, great inertia. The first story is about twice as high as the upper stories and has practically no spandrel walls, being reduced to skeleton piers with glass between. When braced with knees, we have a flexible support, allowing the ground and first floor to move relatively to the upper portion by bending the first-story columns, and so transmitting but little of the ground vibration to the rigid mass above. Rear walls in the first story should be made of a non-elastic and weak material, such as tile, so as to permit freedom of elastic movement.

An earthquake would leave a building of this type entirely or practically uninjured above the second floor; and the walls, partitions and piers in the first story would be damaged in proportion to the severity of the quake. The occupants would be inconvenienced but little, and the property damage would be largely confined to the first story, where it is most easily repaired.

Some calculations made on a building recently constructed in San Francisco indicate that a lateral movement of 2 in. or an amplitude of 4 in. could exist without stressing the steel under combined direct load and bending beyond 40,000 lb., which is near the elastic limit of the material. It is believed that the lateral movement at San Francisco in 1906 did not exceed ¾ in.

If these figures are even approximately correct, I believe the method outlined above indicates the logical design for high buildings in an earthquake zone. I see no logic in doubling the wind stress in the hope that it may somehow do some good. It would be more sensible to decide upon a maximum relative displacement between the first and second, or possibly the third, stories, where the first story is low, of, say, 1 to 1½ in., without exceeding the elastic limit for combined stresses, or for combined wind, live- and dead-loads according to the ordinance, whichever would be the greater.

In connection with minimizing the earthquake damage, it seems to me of great importance that the foundations, except in firm soil, should be thoroughly tied together, in order that there may be no relative movement and that the floor slabs generally should be of such thickness as absolutely to insure no distortion of the floor plan.

After all, good materials and good workmanship combined with common sense and broad-minded designing will insure satisfactory buildings under any reasonable conditions. We cannot expect ordinances alone to insure the best results. They are only needed to protect the public from ignorance, stupidity and rascality.

San Francisco, Calif., May 19, 1927.

C. H. SNYDER, Designing and Consulting Engineer.

Soil Resistance Due to Viscous Flow

Sir—It has often been remarked that time is a factor in the settlement of loaded soil. But the precise action of this factor has not been sufficiently understood to permit introducing it into engineering formulas. I have made some studies and observations in this field and believe I have established an interesting formula. I conclude that the settlements of loaded soils are functions of their resistance to deformation and of the time of loading.

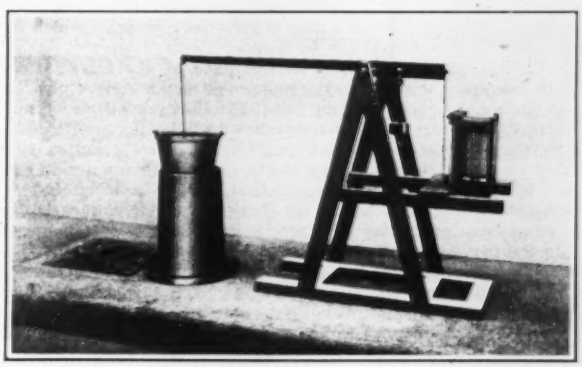


FIG. 1—SOIL TEST APPARATUS

With reference to the second conclusion, a theoretical basis may be established as follows: Starting with the hypothesis that the resistance of the soil is proportional to the square of the velocity of motion through it, we can develop a formula for the rate of settlement of a load through soil. Thus, taking the load P at the surface of soil, and denoting its settlement by y, and time values by t, the downward acceleration of the load will be

$$\frac{d^2y}{dt^2} = P - a\left(\frac{dy}{dt}\right)^2$$

whose integration results in the expression

$$R = P(1 - e^{-2ay})$$

where $R = av^2$ is the resistance of the soil to settlement, P is the load and e is the Naperian base. This expression connects the settlement of loaded soil with soil resistance.

To obtain an expression for the settlement in relation to time, the first equation may be written

$$\frac{dv}{dt} = P - av^2$$

This may be integrated to give v and again integrated to give y, the settlement, the result being

$$y = \frac{1}{a} \log \cosh t \sqrt{\frac{P}{a}}$$

This is an expression for settlement in terms of time, load and the load-resistance constant of the soil. The formulas given are complicated only in appearance. Several authors,

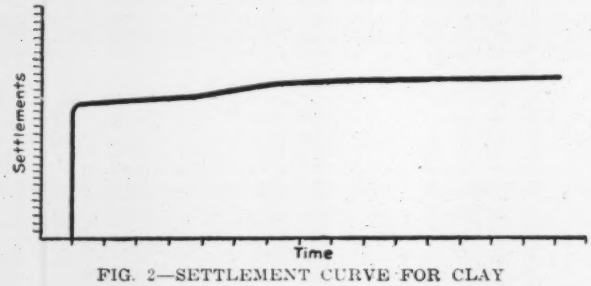


FIG. 2—SETTLEMENT CURVE FOR CLAY

as Zimmermann, Hayashi, and others, have given similar equations for the deformation of ballast under load action.

To supplement the theoretical development, I have experimented on the effect of the time factor with apparatus as shown in the accompanying photograph, Fig. 1. The load on the soil in a vertical cylinder produces settlements which by a lever are recorded on a clock-driven cylindrical sheet of paper. Fig. 2 reproduces a settlement curve obtained in this way for clay under steady load.

Campos, Brazil, E. DE MORAES VIEIRA.
May 2, 1927.

In Defense of the N. J. Health Department's Attitude on Joint Sewage Disposal

Sir—In *Engineering News-Record* June 2, 1927, p. 913, there is printed a letter from Alexander Potter, under the title "Joint Meeting to Build Second and Larger Trunk Sewer." One may, in reading that letter, be led to believe that for four years the New Jersey State Department of Health has placed obstacles in the path of the installation of an adequate sewerage system for the eleven municipalties comprising the joint meeting; that for that period plans and specifications for the new trunk sewer have been with this department awaiting its action. Our interpretation of the letter is that it is not altogether a news item upon a meritorious movement in state sanitation, but, in part, a charge that the State Department of Health was bureaucratic in its consideration of the joint trunk sewer and sewage-works.

In the movement of this project certain special acts of the legislature apply, especially Chap. 26 of the P. L. of 1899, and a supplement thereto, Chap. 174 of the P. L. of 1919. In the latter are these provisos:

> " . . . provided, however, that plans and specifications for the construction of such additions, enlargements, additional branch sewers, works, devices and plants for the purification or other treatment of sewage, shall be submitted to and approved by the Department of Health of the State of New Jersey before the construction of such work is begun; and, provided, further, that no works, devices or plants for the purification or other treatment of the sewage of such municipalities shall be located or constructed in any municipality hereunder without the consent of the governing body of such municipality. . . ."

Under the date of Oct. 6, 1925, Mr. Potter, in a letter to the department, advised that he was not aware until the preceding week of the recently promulgated revised rules and regulations governing the design of sewage disposal plants in the state of New Jersey. He also questioned whether, under the rules, tanks of so small a retention period as specified by him would be permitted. He requested that the department sanction the design of tanks having the retention period he specified, with the understanding that extensions must be made to the plant as the experiences of other cities would justify. This situation is substantiated by the minutes of the board meeting held Oct. 6, 1925, when Mr. Potter appeared before the department and discussed further the facts contained in this letter submitted by him. Instructions were issued by the board to investigate the treatment devices proposed by Mr. Potter and to secure information from the attorney-general upon certain suggestions made by the consulting engineer.

In a conference on Oct. 22, 1925, the consulting engineer advised that data as to sewage flows, sewage analyses, etc., would be submitted by him later, and further, that his proposition for board consideration at that time was a general scheme, details of construction, capacities, etc., to be submitted later for specific approval.

Under date of Oct. 22, 1925, the attorney general was requested for several opinions in this matter; in his reply dated Feb. 18, 1926, be advised "The Act (Chap. 174 of the P. L. of 1919) prohibits the construction of the works until the plans and specifications for the work have been submitted to and approved by the Department of Health. I am of the opinion that a conditional approval of the plans under this act is not permissible. The approval when given must embrace the whole work and be final."

Among the recommendations adopted upon this scheme by the members of the department at a meeting April 6, 1926, when they considered reports by their engineers upon the sewage-treatment plant proposed for the joint outlet sewer, sewage plants inspections in the vicinity of Toronto, Canada, and at Syracuse, New York, and of the opinions of the attorney-general, were: That the departmental requirements for single-story sedimentation tanks with separate sludge digestion apply to the consulting engineer's proposal (this increased the detention period from two to four hours), and that the ultimate treatment—"the whole work"—to which the sewage from the joint sewer is to be subjected, is to be a method of sedimentation and disinfection.

On Sept. 14, 1926, at the monthly meeting of the department representatives of the joint meeting were heard on the construction of its trunk sewer and sewage-treatment plant, and the spokesman for the delegation "agreed with the president" (of the state department) "that the department must have definite plans before it can take action."

In Oct. 1926, civic organizations of the municipalities of Linden and Elizabeth, who are not members of the joint meeting, filed a communication protesting against the location of the sewage-treatment plant for the joint outlet within their municipal limits, and called the attention of the department to the provisos contained in Chap. 174 of the P. L. of 1919.

Under date of Feb. 3, 1927, there was received from the consulting engineer "Addenda to Specifications Covering Reinforced-Concrete Pressure Pipe and 5-in. Sludge Pressure Line." The concrete pressure line relates to the trunk sewer, and upon this the engineer advised that the omission of the specifications for this particular item was due to the fact that even as late as Dec. 21, 1926, he was not satisfied as to the course to be followed.

The joint meeting on Feb. 17, 1927, passed a resolution concurring in the action of its engineer relating to (a) the enlargement of the sedimentation basins, and (b) the additional precautions to be taken to secure tight joints, especially where they extend along, over or under streams. These streams are a source of potable water supply. It is to be noted that the consulting engineer required from April, 1926, to February, 1927, to comply with the requirements of the department relative to detention period at the sewage-treatment plant, and until Feb. 17, 1927, to submit "Addenda to Specifications Covering Sewers Across or Along Streams," which, in principle, is similar to the requirements that he, as consulting engineer, set up in the construction of a sanitary sewer system in Hillside Township, a participating member in the new joint trunk sewer, for which a permit to construct was issued April 6, 1926.

At the regular meeting of the State Department of Health, following Feb. 17, 1927, on March 1, a permit to construct was issued to the joint meeting.

The municipalities comprising the joint meeting have co-operated throughout this project with the Department of Health and are to be complimented for the progress already made in this common enterprise.

Trenton, N. J., H. B. COSTILL, M. D.,
June 6, 1927. Director State Department of Health.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

A.A.E. Meets at Tulsa

Membership Stabilized — Correspondence Schools and Employment Studied—Harris President

(Special Correspondence)

Concentration of activity on subjects of immediate practical interest to engineers marked the work of the American Association of Engineers as brought out in reports presented at the thirteenth annual convention, held last week at Tulsa, Okla. Departing from its previous custom of maintaining committees on many subjects, some of only minor importance to the majority of members, the Association a year ago concentrated its major work on four subjects: employment, compensation, correspondence schools, and public education. The wisdom of this action was reflected in a stabilization of membership, the constant turnover of past years having been checked. The present membership, of nearly six thousand, is about the same as of a year ago, but enrollment is on the up grade.

Correspondence Schools

Of the various committee reports the most significant was that on investigation of correspondence schools. While the committee approves instruction by mail and home study, it points out and opposes the misleading (often actually fraudulent) practices in advertising and follow-up which are quite general among correspondence schools.

It was estimated that there are more than 300 correspondence schools, of which over 80 per cent are privately owned or controlled, including stock companies capitalized as high as $10,000,000, and maintaining a large staff. Their enrollment is reported as over four times that of the colleges, universities and other institutions of higher education; the number of active students in correspondence schools ranges from 100,000 to 225,000, and some 200 subjects are taught, from accountancy to wrestling. While the report deals mostly with abuses in the schools professing to teach engineering subjects, it states that "there are so-called 'universities' and correspondence schools that teach chiropractics, play-writing and dentistry in twelve lessons, and award the degree of 'Doctor of Philosophy' all for $8.50, cash in advance." Practically all of the correspondence schools offering technical training have been investigated, it says, and most of them indulge in misleading advertising, promising prospective students everything from $10,000 per year to job guarantees; in many cases the lessons are poorly written and in other cases the courses are obsolete, written fifteen years ago and never revised.

Employment and Insurance

The report on employment also presented new elements. The central employment office of the association, at Chicago, is successful, but branch offices have been abandoned for the present, as they operated at considerable loss. At New York the branch office work was turned over to a private agency, with moderate success.

A study has been made of the possibility of providing unemployment insurance to cover the lapses in that class of engineering employment where the engagement is of relatively short duration. At the request of the Association, the matter has been intensively studied by several of the larger insurance companies, and it is reported that two of the larger companies are nearly ready to announce the writing of such policies.

The committee reported that many engineers past the peak of their earn-

(Continued on p. 999)

Engineering Fifty Years Ago

From *Engineering News*, June 16, 1877

MEASURES have been taken to secure to the United government the desired ground at the head of Davis' Island, near Pittsburgh, in the Ohio River, for the construction of an experimental, movable dam, and the engineers have been directed to proceed with the work. It is thus intended to test the efficiency of such a system for the improvement of the Ohio River. A channel of 400 ft. in width, which can be thrown open at will, is expected to give ample room for the descent of boats with their large tows of coal barges.

Rise in Mississippi Checked by Spreading into Tensas Basin

The June rise in the Mississippi River which was noted last week as having caused considerable concern due to the reflooding of large areas appears to be passing from the main river into the Tensas Basin through the crevasses in the levee system below Memphis. The Memphis gage has continued to rise during the week and the Vicksburg gage, which had been falling from two to three tenths a day, has remained almost stationary. The area still under water in the Tensas Basin is so extensive that the added water has done little but check the rate of fall. The flood waters in the Atchafalaya Basin are falling slowly. I. M. Cline, meteorologist of the Weather Bureau at New Orleans, estimates that the lower areas in the Tensas and Atchafalaya Basins will not be clear of floodwater until about the end of July.

Record Attendance at A.W.W.A. Meeting

Next Convention on Pacific Coast —James E. Gibson Elected 1927-28 President

(Engineering News-Record Staff Report)

The Pacific Coast certainly and San Francisco probably will be the meeting place of the American Water Works Association in 1928, it was announced at the 47th annual convention of the association, held in Chicago, June 6-11. Promise was held out of making the date such as would fit into summer vacation plans.

Thanks largely to the efforts of the local committee the Chicago convention had the record breaking attendance of over 1,600, of whom some 1,200 were members. As a natural sequence of several years of herculean committee work under the Standardization Council Committee, reports this year were almost absent from the program, but the committee on boiler feedwater studies had two sessions of large attendance and many papers, under the leadership of S. T. Powell, Baltimore, Md. Sectional meetings were also held by the plant operators and the water purification divisions. Superintendents' round-table discussions were a feature of the convention. The Water Works Manufacturers' Association outdid itself in the exhibit halls and in entertainment for all comers, but the smoker had to be cancelled by the sudden death of Charles R. Wood, president of R. D. Wood & Co., one of the most active, useful and best-liked members of not only the manufacturers' but also the American Water Works Association.

Officers Elected

Count of ballots for 1927-28 officers showed that the ticket submitted by a nominating committee had been adopted, as follows: President, James E. Gibson, manager and engineer, Water Department, Charleston, S. C.; vice-president, W. W. Brush, chief engineer, Department Water Supply, Gas and Electricity, New York City (who has served as treasurer for the past six years); treasurer, George C. Gensheimer, secretary Water Commission, Erie, Pa. The new trustees are: Seth M. Van Loan, Philadelphia, L. R. Howson, Chicago.

Forehandedly, nominations for 1928-29 were announced as follows: President, W. W. Brush; vice-president, Jack J. Hinman, Iowa City, Iowa; trustees, C. D. Brown, Walkerville, Ont., S. H. Taylor, New Bedford, John Chambers, Louisville, Ky.

A total membership in all grades of 2,403 on Dec. 31, 1926, was announced by Beekman C. Little, permanent secretary. A budget of over $49,000 for the next fiscal year was adopted.

The Standardization Council, through George W. Fuller, chairman, announced

that during the year a committee on standpipes and water towers had been created, with J. E. Gibson as chairman, and one on steel pipe lines, with J. Waldo Smith, New York City, chairman. More recently two other committees have been decided on—water-works administration and revision of the Manual of Water Works Practice, the latter to have some 20 members, with F. C. Jordan, Indianapolis, chairman.

The Diven Memorial Award, assigned yearly to the active member who by papers submitted, new members secured or other service, is esteemed worthy of it, was presented to Arthur E. Gorman, chief sanitary engineer, Chicago Department of Works, for additions to the membership. The Nicholas Hill cup for greatest gain in district membership went to the Florida section.

At a meeting held Saturday morning, under the auspices of a committee appointed by the executive committee to consider an outlet for papers on sewage research and the operation of sewage-works, the fifty or so present voted against the formation of a sewage section of the American Water Works Association, as reported in more detail, together with other discussions of this and related matters, elsewhere in these columns.

Abstracts of technical papers and discussions will be found beginning on p. 984 and notes on the exhibits on p. 1002.

One of the association activities immediately ahead will be a meeting of the administrative committee scheduled for early August at which time there will be discussed some of the future policies of the association and particularly a program for the stabilization of the Standardization Council.

Costly Railway Line to Be Built in Cumberland Mountains

The Interstate Commerce Commission has authorized the Louisville and Nashville R.R. Co. to construct a new line from Chevrolet in Harlan County, Ky. across the Big Black Mountains of the Cumberland Range to a connection with its line at Hagans in Lee County, Va., a distance of about 15 miles. Construction is to be begun by the end of 1927 and completed by June, 1930. The estimated cost of the work is placed at $6,967,000. The order also provides for operation by the L. & N. over the Interstate R.R. from Norton to Miller Yard, Va., a distance of about 18 miles, where a connection will be made with the Carolina, Clinchfield & Ohio R.R.

This order is the outcome of a condition imposed upon the Atlantic Coast Line and the L. & N. when these two railroads acquired control of the Clinchfield. At that time the commission stipulated that a physical connection should be made between the L. & N. west of the Cumberland Range, and the C. C. & O. to the east. However, on account of the high cost of constructing such a line the commission now has authorized this shorter piece of construction to be supplemented by trackage rights to a connection with the Clinchfield.

Water Works Association Sticks to Water

Two Other Conferences Leave "Outlet" for Sewage Works Data Unsettled—Independent Committee Report

(Engineering News-Record Staff Report)

That the American Water-Works Association has all it can handle in its own field and therefore will not form a sewage section was decided at its Chicago convention last week. Those wishing to consider some other means of co-ordinating and extending organized activities in the field of sewage-works operation and research met immediately after the sewage conference of the water-works association and voted to have the chairman of both meetings (C. A. Emerson, Jr., of Fuller & McClintock, Philadelphia, Pa.) appoint a committee on the subject, without instructions save to arrange for an open conference at the convention of the American Public Health Association next fall.

On the evening before the action just outlined, there was a dinner conference on the same general subject, called by H. P. Eddy, consulting engineer, Boston, Mass., chairman of a committee of the Sanitary Engineering Division of the American Society of Civil Engineers, created to consider the sewage activities of the division and their correlation with those of other organizations. Mr. Eddy called the dinner conference solely for the purposes of discussion—which was extensive but showed little unanimity of opinion. There were thus three sewage conferences at the A.W.W.A. convention, attended by substantially the same group of perhaps 60 sanitary engineers, chemists and biologists, nearly if not all members of the A.W.W.A.

Basis of Decision

The decision not to form a sewage section in the A.W.W.A. was based on an analysis of the problems and finances of the association, outlined by Abel Wolman in behalf of a special committee created by the executive committee to consider a possible "outlet" for papers on sewage research and on the operation of sewage-works. Mr. Wolman stated that the $18,000 budget allowance for the *Journal* is insufficient to print the papers on water-works available; that large sums are in demand for the work of committees on steel pipe lines and boiler feed waters, the latter alone needing $50,000 in the next five or ten years. Moreover, although there are 10,000 water-works in the United States and Canada, the association has only 2,500 members; and besides extending its membership in the water-works field, there is still much to do in the way of consolidation of water-works associations.

The inadvisability of A.W.W.A. expansion outside its own field having been set forth, Mr. Wolman reviewed other organizations which might go more extensively than now into sewage matters, but found that none of them could do so without embarrassment. He suggested a federation of the sewage activities of existing organizations, with occasional joint meetings rather than the creation of a new society; also the central collection and publication of sewage papers, through some existing technical society or some regular publisher.

Other speakers stated that the New Jersey Sewage Works Association has already voted to publish a quarterly, open to other societies and urged the formation of still other state associations of sewage-works operators, and the affiliation of these and other societies wholly or partly concerned with sewage disposal.

In advocacy of a sewage-works section of the A.W.W.A., I. W. Mendelsohn, sanitary engineer, U. S. Public Health Service, assumed that the 400 members of the Water Purification Division would all be interested in a sewage section, as also some 500 others he had checked off in the list of members, making 43 per cent of the membership. He also presented the result of a letter canvass of the geographical sections, showing that of 15 sections, 7 favored a sewage-works section, one reported that the matter would be taken up later and 7 had not yet replied.

C. M. Baker, engineer, Michigan Department of Health, in pleading for a broad plan of action, named eleven organizations which he thought should co-operate; American Association of Manufacturers, Izaak Walton League, Am. Soc. C. E., A.W.W.A., Am. Chem. Soc., Am. Biol. Soc., A.P.H.A., A.S.M.I., State San. Engr., U. S. Public Health Service and the U. S. Fisheries Bureau

On being requested for an expression of opinion, Homer Calvert, secretary, A.P.H.A., and editor of its *Journal*, suggested a careful survey to find out how many papers on sewage-works lack a place for publication. Robert S. Weston, consulting engineer, Boston, said that a sewage section of the A.W.W.A. would be an example of working in parallel, whereas he believed the better plan would be to work on the series system; that is keep water and sewage matters separate. The final outcome of the three conferences was to leave no organization committed to any plan but, as already stated, to create an uninstructed committee of investigation, apart from either the A.W.W.A. or the committee of the Am. Soc. C. E. already in existence.

Industrial Harbor Opened in Chicago District

A harbor built at Buffington, Ind., by the Universal Portland Cement Co. for receiving limestone brought by water for the cement mills, was opened officially June 9 by a flag-raising ceremony with Charles G. Dawes, vice-president of the United States, as guest of honor in the large crowd of visitors which went from Chicago in two chartered steamers. The harbor is an enclosed basin having on one side a stock yard with concrete dock wall. Part of the stone is delivered by steamers having machinery for discharging the cargo onto the stockpile. For stone delivered by steamers of the ordinary bulk-freight class there is a traveling unloader crane, which spans the stock yard and carries a 10-ton grab bucket.

Charles R. Wood Dies Suddenly at Chicago

Charles R. Wood, president of R. D. Wood & Co., Philadelphia, Pa., died suddenly June 8, while attending the convention of the American Water Works Association in Chicago. Mr. Wood had for a number of years been an active member of the A.W.W.A. and was engaged in its work both in committee and general business up until the time of his death.

Mr. Wood was born in Rome, Italy, in 1871. After being with R. D. Wood & Co. from 1893 to 1897 he took outside positions for a few years, but returned as sales manager and engineer in 1901, afterwards becoming director, vice-president and then president. Mr. Wood invented a nozzle cut-off and improvements in high pressure hydrants. He was a member of the American Society of Mechanical Engineers, American Society for Testing Materials, American Iron & Steel Institute, American Institute of Mining & Metallurgical Engineers and of the American Water Works Association.

A.A.E. Meets at Tulsa

(*Continued from p. 997*)

ing power have failed to provide for approaching incapacity, and that it has found a willingness among employers of engineers to assist in providing a foundation as a nucleus of a retirement fund.

Study of adequate compensation is being made by letters addressed to employers of engineers requesting frank statements of opinion as to the reasons why the salaries of engineers are not more in keeping with their responsibilities and qualifications. Some very interesting replies have been received, and the work is still in progress. In this connection, the president's address called attention to the growing danger of the younger and less responsible members of the profession embracing unionism, and the fact that large numbers have already joined. The Association reaffirmed its position against unionism, as contrary to the interests of engineers. Among the other resolutions adopted, those of most interest include the conferring of honorary membership on Colonel C. A. Lindbergh; requesting the President of the United States to appoint a committee of engineers and others to study flood control in the Mississippi drainage area; requesting Congress to establish a Department of Public Works, and relating to the establishment of a University of the United States.

Operating expenses were reduced during the year by more than $16,000 in the face of the increased activities. It was reported by the treasurer that the Building Fund, established last year, now exceeds $9,000.

M. R. Harris, former vice-president, was elected president of the Association for the coming year. The new vice-presidents are Donald M. Baker, of Los Angeles, and Dan Patton, of Tulsa. Miss M. E. McIver has been promoted from acting secretary to secretary. El Paso was selected as the place of the next convention.

States Given Right to Tax Interstate Motor Traffic

Full Authority Conferred by U. S. Supreme Court in Indiana-Ohio Controversy

Affirmation of the full right of a state to tax motor vehicles carrying on entirely interstate traffic is made by U. S. Supreme Court decision in a case carried to it by Clark & Riggs, a firm doing motor truck haulage across the Indiana line and in litigation with the state of Ohio. The Ohio motor transportation act provides that in case of motor-vehicle haulage for hire certificate must be obtained and a tax paid according to the number and capacity of vehicles used. The firm in question doing an entirely interstate business between Aurora, Ind., and Cincinnati, Ohio, ignored the provisions of the act and brought suit in the local federal court to restrain the Ohio public utilities commission from its enforcement. The bill was dismissed by the local court and appeal was then made to the U. S. Supreme Court which affirms the previous decision.

Justice Brandeis, delivering the opinion, said:

"The plaintiffs claim that, as applied to them, the act violates the commerce clause of the federal constitution. They insist that, as they are engaged exclusively in interstate commerce, they are not subject to regulation by the state; that it is without power to require that before using its highways they apply for and obtain a certificate; and that it is also without power to impose, in addition to the annual license fee demanded of all persons using automobiles on the highways, a tax upon them, under Sec. 614-94, for the maintenance and repair of the highways and for the administration and enforcement of the laws governing the use of the same.

"The contrary is settled. The highways are public property. Users of them, although engaged exclusively in interstate commerce, are subject to regulation by the state to ensure safety and convenience and the conservation of the highways. Users of them, although engaged exclusively in interstate commerce, may be required to contribute to their cost and upkeep. Common carriers for hire, who make the highways their place of business, may properly be charged an extra tax for such use.

"There is no suggestion that the tax discriminates against interstate commerce. Nor is it suggested that the tax is so large as to obstruct interstate commerce.

"It is said that all of the tax is not used for maintenance and repair of the highways; that some of it is used for defraying the expenses of the commission in the administration or enforcement of the act; and some for other purposes. This, if true, is immaterial.

"Since the tax is assessed for a proper purpose and is not objectionable in amount, the use to which the proceeds are put is not a matter which concerns the plaintiffs."

Guy E. Tripp Dies

Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Co., died at New York on June 14 following a long illness. Mr. Tripp was born at Wells, Me., in 1865 and began work as a clerk for the Western Railway Co., at Salem, Mass. In 1897 he joined the firm of Stone & Webster, Boston, later becoming vice-president of the Stone & Webster Management Association and of the Stone & Webster Management Corporation. During the bankruptcy of the Metropolitan Street Ry. at Boston he was appointed chairman of the joint committee on reorganization. In 1912 Mr. Tripp was chosen to be chairman of the board of the Westinghouse Electric & Manufacturing Co., a position which he held until the time of his death.

During the war Mr. Tripp entered the government service as a major, becoming chief of the production division of the Ordnance Dept. and later assistant to the Chief of Ordnance with the rank of brigadier general. For this service he was awarded the Distinguished Service Medal. Since the war General Tripp has been active in promoting the development of a superpower system throughout the eastern states.

Western Society Confers Annual Honors

The addition of two distinguished engineers, Bion J. Arnold and Arthur N. Talbot, to the list of honorary members of the Western Society of Engineers was announced at the annual dinner of the society, held in Chicago on June 1. Brief addresses of acknowledgment followed the announcement. The Washington Award was presented to Orville Wright in recognition of his fundamental research work in the development of aviation.

An award established by the late Robert W. Hunt for papers on iron and steel manufacture, by members under 35 years of age, was presented to William J. Farrell, Jr., for his paper on "Calcium Carbide as an Agent for Removing Sulphur and Phosphorus from Iron and Steel." A dozen past-presidents were among the 500 members and guests at the dinner.

In his presidential address, F. E. Morrow, retiring president, reviewed the increasing activities of the society, and referred to its contract for future quarters in the Engineering Building, now under construction. There are now more than 2,500 members, with 41 elected in 1926-1927, and a loss of 17 by death. At the 36 regular meetings the attendance aggregated 8,226, but with the 28 meetings of junior members and certain special meetings, the aggregate number reached 10,460, an increase of 26 per cent over the former highest record. The finances are in good condition and $1,100 were spent on the library. Officers for 1927-1928 are as follows: President, Rufus W. Putnam, chief engineer, Chicago Harbor Plan; vice-presidents, John A. Garcia, William S. Monroe and D. J. Brumley; treasurer, George W. Hand. The secretary is Edgar S. Nethercut.

Turbine Patent Decision from U. S. Circuit Court of Appeals

The United States Circuit Court of Appeals, after a hearing in Atlanta, Ga., has just handed down a decision in the suit brought by the Allis-Chalmers Co. against the S. Morgan Smith Co., alleging infringement by the latter company in the use of pressed steel casings for hydraulic turbines. This court found the defendant guilty of infringement, thereby reversing the decision of a lower court from which the case had been appealed. The decision holds the patent valid and finds that the changes in construction made by the S. Morgan Smith Co. do not avoid infringement.

Seacoast Urged as Public Utility at Preservation Meeting

That the entire seacoast, with its beaches, should be regarded as a public utility, subject to state regulation, for use and benefit of all the people, was the keynote of the meeting of the American Shore and Beach Preservation Association held in Washington, D. C., on May 23 and 24. It was pointed out that Massachusetts, New Jersey, and Delaware have already passed legislation creating commissions to safeguard and develop their shores and beaches.

The American Shore and Beach Preservation Association is sponsored by the Committee on Shoreline Investigations of the National Research Council and its corporate membership includes only official state and municipal agencies concerned with shore and beach protection. Its sphere of interest embraces not only the coasts but also the shores of our lakes and rivers. One of its purposes is to collect and disseminate information looking toward improved and economical protection of the coasts, shores and rivers of the country that they may be properly preserved for the use and enjoyment of the people.

It has been demonstrated by the experience of the members of the association that coast protection works are most adequate, safe, permanent, and economical when such works are planned and executed under the supervision of some permanent state agency. For this reason, a resolution was adopted at the Washington meeting recommending that all coast-line states delegate to some state agency, either by executive or legislative enactment, the necessary powers to formulate and carry out a well-conceived and continuous program of shore and beach protection for each state. The program of the association further contemplates that these agencies will co-operate with one another and with the federal government in seeking the solution of the many unsolved problems which today make shore protection one of the most uncertain matters with which the engineering profession is called upon to deal.

With a view toward federal co-operation, State Senator Allen, of New Jersey, presented a resolution, which was adopted by the association, that the secretaries of War, Agriculture, Treasury, Commerce and Interior should designate representatives of certain bureaus officially credited to the association. Notable among the bureaus named were the U. S. Engineers, Coast and Geodetic Survey, Weather Bureau, Coast Guard, Lighthouse Service and Geological Survey. At the present time, several federal engineers are actively engaged, semi-officially, in the work and problems of the association under authority of the executive order directing co-operation with the National Research Council.

With respect to flood prevention and protection activities on the Mississippi River and its tributaries, the opinion of the association, as expressed in a resolution, was that "No steps toward flood-protection relief on these rivers should be taken except after investigation and approval of the U. S. Engineers, the Mississippi River Commission and other competent authorities charged with consideration of these matters."

Brief News

An Engineering Commission Headed by John A. Garcia has been sent to Russia by the Allen & Garcia Co., consulting engineers, Chicago, this company having been retained by the Union of Socialistic Soviet Republics, through the Amtorg Trading Corporation, to lay out coal-mining plants according to American practice and to report in detail upon the cost and operating economies under American methods.

The Report of the Canadian National Rys. engineering party, which was engaged from Jan. 9 to April 4 last on the survey of a possible railway line to Fort Churchill, has been received by the Dominion Government. The engineers find that it would be no more difficult to build and maintain a line of railway to Churchill than has been experienced on other parts of the Hudson Bay Ry. The line to Churchill would be 154 miles long as against 67 miles to Nelson, and the cost to Churchill would be $7,543,000, as compared with $2,458,000 to Nelson. The foregoing estimates include half a million for yearly terminals at either place. The engineers believe the line to Churchill could be completed in two working seasons, or by December, 1929, and the line to Nelson by December, 1928.

A 32-Mile Gas Main of 48-in. diameter will be formed at Chicago with the completion of the 11½-mile section now under construction. The entire line is cast-iron pipe, in plain cylindrical sections put together with bolted sleeve joints having rubber gaskets. Its main source of supply is the gas plant at 35th St. and Crawford Ave., and it is expected to distribute as much as 200,000,000 cu.ft. of gas per 24 hours through the system, which will include numerous laterals.

In Order to Indicate More Definitely its purview, the College of Applied Science at the University of Iowa has been renamed College of Engineering. The change is in name only, inasmuch as the curricula and researches of this college have always been confined to engineering and the nature of its activities is not affected.

Earth Dam on Maquoketa River in Iowa Washed Out

A section of the earth embankment at the north end of the Iowa Railway & Light Co.'s power dam on the Maquoketa River, near Maquoketa, Iowa, failed on June 1 and about 100 ft. of the embankment was washed out. The dam was completed in January, 1924. It consists of a power-house and spillway section of hollow reinforced-concrete construction across the main channel of the river, flanked by a small earth embankment on the south shore and a much longer embankment on the north shore, extending across the bottomland to the bluff. It was the portion of the latter embankment where it joins the concrete dam which failed. This dike is about 20 ft. high and 450 ft. long. It consists of compacted earth without a core wall, the upstream half of the embankment being built of selected impervious soil and the downstream half of pervious sand and gravel with a system of underdrains. The dam was described in *Engineering News-Record* May 7, 1925, p. 762.

No information as to the cause of failure is available at the present time. Local press reports state that unusually heavy rains had occurred before the failure and that the embankment had become saturated.

Steel Transmission Tower Tested

A full-sized structural steel transmission tower withstood successfully complete loading tests made last week at the plant of Blaw-Knox Co., Pittsburgh, where it was built. Transmission towers of similar design will be used on the Conowingo hydro-electric project of the Philadelphia Electric Power Co. Day & Zimmerman, Inc., Philadelphia, has the contract for the design and construction of the transmission line, and supervised the tests. Details of the test will be included in a subsequent issue.

Norman Victim Relatives Win Second Fight

Action of Federal Judge Harry B. Anderson, Memphis, Tenn., in overruling demurrers to two declarations for damages under the Norman act will be carried to the United States Circuit Court of Appeals.

In overruling the governmental demurrers Judge Anderson held that the Norman act is a remedial act and that it places the government in the same category as a private citizen as insisted by Metcalf, Metcalf & Apperson, attorneys for two widows seeking damages for the deaths of their husbands on board the M. E. Norman May 8, 1925, when it overturned while taking a party of civil engineers down the Mississippi River.

The decision was the second victory scored by relatives of Norman victims in their long fight to secure compensation for their loss suffered when the steamer M. E. Norman sank below Memphis two years ago. The first victory was the passage of the act of Congress.

Personal Notes

T. C. EPPS, formerly architectural engineer and construction superintendent with Royer, Danely & Smith, architects, Urbana, Ill., has accepted a similar position with the firm of William B. Ittner, Inc., architects and engineers, St. Louis, Mo., and for this firm is superintending the construction of a large high school project at Longview, Wash.

FRED M. LOCKWOOD, who was the first manager of operation under the present charter of the city of San Diego, Cal., serving from 1915 to 1919, has been again appointed to the position, succeeding Fred A. Rhodes, who has held the office for the past eight years.

THOMAS BLAIR, assistant engineer of the Atchison, Topetha & Santa Fe Ry., has been appointed division engineer with office at Slaton, Tex.

M. J. RUTLEDGE, has been appointed city manager of St. Lambert, Que. Mr. Rutledge is a graduate of the University of New Brunswick, and was formerly manager of the town of Woodstock, N. B. He is a member of the Engineering Institute of Canada.

MACKIE-THOMPSON-TAMM, Inc., is a new engineering contracting firm which announces the opening of offices in the Builders Building, Chicago. The firm is composed of N. S. Mackie, formerly manager of the Soo Dredging & Construction Co.; George E. Tamm, formerly superintendent of the Great Lakes Dredge & Dock Co., and H. A. Thompson, formerly division engineer of the latter company.

H. E. STUCKERT, assistant engineer of the Houston Belt & Terminal R.R., Houston, Tex., has been appointed division engineer of the Houston North Shore Ry. (Missouri Pacific Lines).

T. A. YOUNGBLOOD, assistant division engineer of the International-Great Northern R.R., has been appointed assistant engineer of the Houston Belt & Terminal R.R. Both of these roads are included in the system of the Missouri Pacific Lines.

GEORGE CLINTON WARD, vice-president in charge of engineering and construction for the Southern California Edison Co., has received the degree of doctor of engineering from the University of Southern California for his work in developing water power, especially the Big Creek-San Joaquin project of which the Florence Lake tunnel is a part.

V. L. NELSON has been appointed acting valuation engineer, New York Central R. R., Ohio Central Lines, vice H. F. SCHRYVER, who is now engaged upon duties in another department.

J. T. MADISON, of Millersburg, Ky., has returned to the Kentucky State Highway Department as resident engineer in Anderson County from Florida, where he has been for over two years on highway and municipal work in Polk County. Mr. Madison, who is a graduate of the University of Kentucky, formerly served in the central office of the Kentucky Highway Department for four years in various executive capacities.

A. C. MCVEY, who has been on the engineering staff of the Department of Public Works, New Brunswick, for over twenty years, has been appointed chief bridge engineer of the department in succession to the late A. R. WETMORE.

GEORGE COUTTS, formerly assistant engineer, Trent canal, Peterboro, Ont., has been appointed resident engineer on highway construction at Melita, Man.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, French Lick, Ind., June 20-24, 1927.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, New York City; Annual Meeting, Orono, Maine, June 27-30, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Summer Meeting, Denver, Colo., July 13-16, 1927.

The Springfield Engineers Club, Springfield, Ill., at its meeting on June 8, had a paper on the new six-mile Moffat Tunnel through the Continental Divide, near Denver, Colo., by W. C. Cunningham, head of the engineering department of the University of Illinois.

The Society of Industrial Engineers, at its recent annual meeting in Chicago, had the human side of industry and plant management as the underlying subject of its proceedings. In a paper on "Science in Management," Dr. Kimball, dean of the college of engineering at Cornell University, said that if the engineer will apply his training and experience in productive lines to the problems of distribution of the products and profits of industry he can effect greater improvements than any other profession. The same view was presented by C. E. Knoeppel, manager of the Waste Eliminator Co., who considered that both products and profits can be increased greatly by recognition of the human side of the employee. One meeting was devoted to papers on the training of industrial engineers. Another was devoted to the question of fatigue in factory work, with noise reduction and rest periods as related to this problem. The officers for 1927-1928 include: President, W. F. Rittman, Pittsburgh, Pa.; secretary, George C. Dent, Chicago (both re-elected.)

The New England Water Works Association will hold its annual outing June 21 together with the Boston Society of Engineers, at Amesbury and Haverhill; inspecting first at Amesbury a new coke and sand filtration plant and pumping system developing water supply from new wells, and then proceeding to Haverhill for historical sight-seeing and later to pumping stations at Millvale and Kenoza. The day will close with sports and dancing at the Kenoza Country Club.

Obituary

LOUIS C. KELSEY, consulting engineer, Nogales, Ariz., died May 30 in that city, aged 60 years. Mr. Kelsey was born in Kentucky. After two years of railroad work in engineering and water service for the Santa Fe and Union Pacific, Mr. Kelsey served Salt Lake City, Utah, as an assistant engineer, assistant city engineer, and then two periods as city engineer, 1901 to 1904 and 1906 to 1909. Then for seven years he was consulting engineer for the Oregon State Board of Health. Following that, he carried on consulting engineering practice in Salt Lake City, Portland, Ore., Nampa, Idaho, and Nogales, Ariz., to the time of his death. He was also president of and consulting engineer for the Cia Explotodora de Occidents, S. A., Nogales, Sonora, Mexico.

JAMES C. WONDERS, Omaha, Neb., district engineer of District 8 of the U. S. Bureau of Public Roads, died June 6, after a long illness of pernicious anemia, at the age of 67 years. Mr. Wonders was born in Ohio and was graduated in engineering from Ohio State University in 1883. He was city engineer of Bellefontaine, Ohio, from 1884 to 1901. He was also county engineer of Logan County for two periods and was at the same time employed on special work by the Ohio Canal Commission and the Ohio State Board of Public Works. He served as state highway commissioner of Ohio from 1908 to 1911 and then joined the federal bureau, being promoted to senior highway engineer in 1912 and to district engineer in 1916. One of the first concrete pavements was laid by Mr. Wonders in Bellefontaine in 1893.

ERNEST STENGER, president of the Denver Tramway, Denver, Colo., died in that city, May 8, of pneumonia, aged 62 years. Mr. Stenger was born in Alsace and came to the United States at an early age. He graduated in 1886 in civil engineering at the University of Michigan. For many years he was engaged in steam railway work, as rodman with the Burlington & Missouri River R.R., as draftsman with the Atchison, Topeka & Santa Fe, and in 1890 as assistant engineer with the Missouri Pacific Ry. In 1900 he became a division engineer with the Union Pacific Ry. and later served as assistant superintendent and division superintendent. In 1907 he was made general superintendent of the Rio Grande Western Ry., and continued in that capacity until 1911 when he became general manager of the St. Joseph & Grand Island Ry. Later he returned to the Union Pacific as superintendent of the Southern Division. In 1920 he was elected president of the Denver Tramway Co.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

Record Growth for 1927 Water-Works Show

Ninety Two Manufacturers Exhibited Their Products at A.W.W.A. Convention in Chicago

THE EXHIBIT of water-works equipment shown annually in connection with the convention of the American Water Works Association, although showing a steady growth for the past several years, has always been somewhat retarded by lack of sufficient exhibit space. This year, however, the Hotel Sherman, in Chicago, provided the necessary space and the number of exhibitors was increased 16 per cent over that of any previous year, the total number being ninety-two.

As usual, there was shown practically everything a water-works man uses in the way of equipment and materials, with the exception of those products used in construction, and even these were represented in one or two cases by models.

For purposes of classification, the exhibits may be divided into 10 classes, consisting of 4 exhibits of chlorinating equipment and chemicals, 5 exhibits of filtration equipment, 16 exhibits of meters and meter boxes, 17 exhibits of pipe and pipe auxiliaries, 12 exhibits of pumps and well apparatus, 5 exhibits of construction and repair equipment, 17 exhibits of valves, fittings and hydrants, 3 exhibits of steel tanks, 4 exhibits of indicating instruments, and 9 exhibits of miscellaneous equipment and publications.

Chlorinating Equipment and Chemicals—Much interest was shown in the chlorinating equipment not only by the water-works men, but by the state sanitary engineers whose convention had closed immediately preceding the water-works convention. Paradon Mfg. Co. showed a new type chlorinator of a non-injector type, and a new thermo type chlorinator for use with 100-lb. cylinders of chlorine in addition to its standard direct feed injector type solution feed chlorinators. Wallace & Tiernan exhibited manual, semi-automatic and automatic types, in addition to chlorine control apparatus, chloroscales, dry feeders, and ortho-tolidine testing outfits. The La Motte Chemical Products Co. exhibited new equipment for the determination of residual chlorine using an ortho-tolidine solution in addition to its comparator set for determination of hydrogen-ion concentration. A new swimming pool comparator set, including both phenol red and ortho-tolidine solutions for determining both pH values and residual chlorine, was also shown. The General Chemical Co. also was represented.

Filtration Equipment—The Dorr Co. exhibited a working model of its clarifier. For treating locomotive feed water, the Dearborn Chemical Co. exhibited its complete self-contained apparatus. Filter sand was shown by the United States Silica Co., while the International Filter Co. and F. B. Leopold Co. maintained exhibits of their various types of filtration equipment.

Meters and Meter Boxes—The 16 exhibits of meters and meter boxes were as follows: W. P. Taylor Co., Builders Iron Foundry, H. W. Clark Co., Ford Meter Box Co., Badger Meter Mfg. Co., Buffalo Meter Co., Federal Meter Co., Gamon Meter Co., Fred W. Hanks, Hersey Mfg. Co., National Meter Co., Neptune Meter Co., Phoenix Meter Co., Pittsburgh Equitable Meter Co., Thomson Meter Corp., and the Union Water Meter Co.

Pipe and Pipe Auxiliaries—Of special interest among the pipe exhibits were the brass goosenecks shown by the American Brass Co., and a new self-calking lead and steel joint of the Lock Joint Pipe Co. Other companies exhibiting pipe were the American Cast Iron Pipe & Foundry Co., Lead Lined Iron Pipe Co., Central Foundry Co., East Jersey Pipe Co., Cement Lined Pipe Co., McWane Cast Iron Pipe Co., National Cast Iron Pipe Co., National Tube Co., U. S. Cast Iron Pipe & Foundry Co., and R. D. Wood & Co.

The Hydraulic Development Co. exhibited its Lead-Hydro-Tite, furnaces and other equipment used in making bell-and-spigot cast-iron water pipe joints, while the Leadite Co. showed its melting furnaces and braided hemp.

Pipe coatings were exhibited by the Joseph Dixon Crucible Co., which showed graphite paint of silica, red lead and aluminum, by the Ohio Varnish Co. and the Wailes-Dove-Hermiston Corp.

Pumps and Well Apparatus—A new vertical non-clogging pump was exhibited by the American Well Works, while the Automatic Primer Co. showed primers for centrifugal pumps which eliminated the use of foot valves.

The Sullivan Machinery Co. showed an operating model of its "air-made" well in addition to its portable compressors. Other pump exhibits included Birch Mfg. Co., Wm. H. Cater Co., A. D. Cook, Inc., De Laval Steam Turbine Co., Edson Mfg. Co., Edward E. Johnson, Inc., Layne & Bowler Co., Worthington Pump & Machinery Corp., and the Keystone Driller Co.

Construction and Repair Equipment—An operating model of its vertical boom ditcher was exhibited by Barber-Greene Co. as the main item of construction equipment shown. For repair and construction work, Joseph G. Pollard Co. showed lead melting furnaces and other equipment used in laying and calking water mains, and the A. P. Smith Mfg. Co. exhibited its tapping machines, sleeves and valves. Waterworks Equipment Co. and the National Water Main Cleaning Co. also maintained booths featuring their repair and construction work.

Valves, Fittings and Hydrants—Among the new products exhibited in this class of equipment was that shown by the Automatic Cone Valve Co., which consisted of a special check type valve actuated by pump line pressure and having as its most interesting detail a mechanism which lifts the gate from its seat before revolving it to open the line. George H. Snell exhibited patent pipe couplings and tees for threadless pipe; and other manufacturers showing valves, fittings and hydrants included the Columbian Iron Works, Eddy Valve Co., Glauber Brass Mfg. Co., Hays Mfg. Co., Iowa Valve Co., Kennedy Valve Co., Ludlow Valve Mfg. Co., Michigan Valve & Foundry Co., Muelleh Co., Red Hed Mfg. Co., Rensselaer Valve Co., Ross Valve Mfg. Co., George H. Snell, Traverse City Iron Works, Vogt Bros. Mfg. Co., and Waterous Fire Engine Works.

Steel Tanks—Steel tanks, pipe lines and miscellaneous plate work were featured by the Chicago Bridge & Iron Works, Penstock Construction Co., and the Pittsburgh-Des Moines Steel Co.

Indicating Instruments—Indicating and recording instruments of various types for water-works use, including filter rate of flow controllers, loss of head and rate of flow gages, air release valves, pressure gages, etc., were shown by Simplex Valve & Meter Co., Republic Flow Meters Co., and R. W. Cramer & Co., Inc. W. & L. E. Gurley exhibited its engineering and surveying instruments and such hydraulic measuring apparatus as current meters, water level recorders, and hook gages.

Miscellaneous—Companies not previously classified included the Pitometer Co., featuring its recording Pitometers, and the Pittsburgh Testing Laboratory featuring its service to the engineering profession. The Burroughs Adding Machine Co. was a new exhibitor, showing its adding and calculating machines and public utility billing and ledger posting machines. The remainder of the exhibits were maintained by the publications in the water-works field.

Waterworks Manufacturers Elect New Officers

At the annual meeting of the Waterworks Manufacturers Association in Chicago, June 9, the following new officers were elected: President, J. E. O'Leary, Pittsburgh-Des Moines Steel Co.; vice-president, R. K. Blanchard, Neptune Meter Co. Wm. R. James, Mueller Co., treasurer, and J. A. Kienle, Mathieson Alkali Works, secretary, retain their offices for 1927-28.

Business Notes

PORTLAND CEMENT ASSOCIATION announces the opening of an office in Helena, Montana, in charge of A. L. Strong. Mr. Strong has been on the district office staff of the association

at Yakima and Seattle, Wash., since 1920, prior to which he was engaged for ten years in city and county engineering.

BUBLITZ MACHINERY CO. has recently been organized with office and warehouse at 2139 Washington St., Kansas City, Mo., to handle a complete line of construction equipment. W. J. Bublitz, who has organized the company, has been for the past seven years with the Funkhouser Equipment Co., Kansas City, Mo.

NOVO ENGINE CO., Lansing, Mich., announces that D. R. Hoadley, secretary, director, and acting treasurer of the company, tendered his resignation June 1. Mr. Hoadley came with the company 13 years ago as advertising manager, later managing the eastern sales district in New York and was most recently in charge of the financial accounting work at the home office.

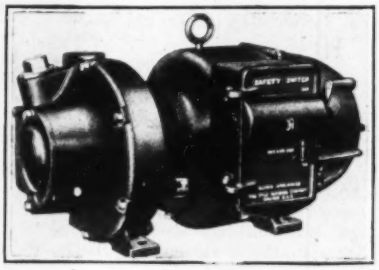
LINCOLN ELECTRIC CO., Cleveland, announces that G. N. Bull has been made district manager of its New York office. C. S. Freeman, formerly in the Lancaster office, has been transferred to the Buffalo office and made district manager. S. W. Shultz, formerly of the Philadelphia office, has been put in charge of the Lancaster office.

INDEPENDENT PNEUMATIC TOOL CO., Chicago, announces that E. R. Wyler, formerly of the Cleveland branch, has been transferred to the sales department of the general offices and will make his headquarters in St. Paul, Minn.

New Developments

Turbo-Generator for Isolated Power and Lighting

A new 2½ kw. turbo-generator which is completely self-contained and suitable for use in furnishing light or current for portable tools in oil fields and on construction work, has recently been developed by the Pyle-National Co., Chicago. For floodlight illumination on construction work, the unit will handle a pair of 500-watt flood lamps with an additional string of 15 100-watt lamps. Since uniform steam pressures are not likely to be encountered on such work, an automatic regulating mechanism has been provided which will maintain uniform voltage under extreme fluctuations of steam pressure or load.



Heavy duty ball bearings and large capacity oil chambers enable the unit to run for months at a time without attention. The unit is of course waterproof and weatherproof. It is complete in itself, an enclosed fuse panel and safety switch box being provided as integral parts of the generator in place of the usual terminal box.

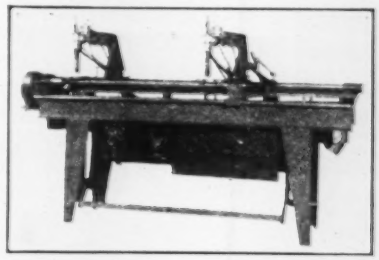
New Level Designed for Quick and Accurate Set-Up

The new auto-set surveyors level manufactured by E. R. Watts and Son, Ltd., 123 Camberwell Road, London, S.E. 5, is not a so-called delicate, high precision instrument. It is, however, claimed to be equal in optical performance to the best 10-in. and 12-in. dumpy levels, in addition to being sturdy and about three times more rapid in operation. The results in fairly clear weather can be established to an accuracy of 1/100 ft. in 500 to 600 ft.

The new level has been designed on an entirely new principle. After the instrument is rough-leveled, the telescope and bubble remain stationary while the fine adjustment is made by tilting the line of sight up or down by optical means. Increased rigidity is obtained by the elimination of foot screws. Rough leveling is done by the pendant lever shown in the accompanying illustration. This rough leveling brings to a central position the bubble of a small spherical level mounted on the side of the telescope. Final adjustment is then made by turning a screw which tilts the line of sight without tilting the telescope.

New Machine Does Butt Welding by Carbon Arc Process

Most butt welding has heretofore been done by a resistance welder. The Lincoln Electric Co., Cleveland, Ohio, has recently developed an automatic butt welding machine using the carbon arc process. It is said that the new arc butt welder is not an alternative method of doing butt welding, but that it is a solution to a class of butt welding problems which the resistance welder cannot solve. As an example, a plug may be welded into the end of a tube with the arc butt welder very easily, although the job would be impossible with a resistance butt welder. It is claimed that the use of the arc butt welder does not involve difficulties with power supply encountered with resistance butt welding. The motor generator sets supply direct current at 40 to 60 volts. The motor is a standard induction motor.

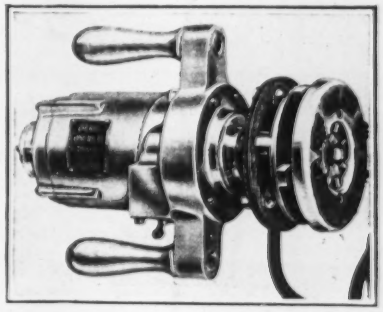


Especially High Lift Features New Road Grader

A new grader has recently been developed by the Rome Mfg. Co., Rome, N. Y., so arranged that the heel of the moldboard can be raised enough to allow the blades to be operated at a 50-deg. angle. The grader also incorporates other important features, chief among which is the use of cut gears running in oil. Steel castings are used throughout and disk wheels are standard equipment. The latter are made from ¼-in. boiler plate and the disk wheels are designed to hold the machine in position when ditching. Long roller bearings are used on all four wheels. A steering device similar to that used on automobiles is operated from the rear platform. The extreme angle to which the moldboard may be set permits bank sloping to be done and eliminates the necessity of attaching a bank sloper several times a day.

Concrete Surfacer Improved

The electric concrete surfacer and finisher manufactured by the Concrete Surfacing Machinery Co., Cincinnati, Ohio, has been improved in a number of particulars and two new models developed. These are known as the Berg Universal and the Berg Regular. The Berg Universal is illustrated herewith. It uses a ¼ hp. G.E. motor and weighs 12 lb. The Berg Regular uses a ⅛ hp. G.E. motor and weighs 23 lb. which is 10 lb. lighter than the older model. It is claimed that 50 per cent more power is possible with these new models than with the older ones and that a greater efficiency can be guaranteed.



New Publications

Road Machinery.—AUSTIN-WESTERN ROAD MACHINERY CO., Chicago, recently published its 1927 catalog including all of the improvements and additions which have been made to its line during the past year. A distinct attempt has been made to convey the description of each piece of equipment with the least possible reading matter. Large size illustrations are used together with operating pictures. The catalog contains 52 pages, practically every page of which is devoted to a different piece of equipment.

Power Shovels.—INSLEY MFG. CO., Indianapolis, Ind., has devoted catalog No. 51 to a description of its excavator with its various attachments for shovel, ditcher, skimmer scoop, crane, dragline, backfiller and magnet operation. A general description, descriptions and photographs of the mechanical details, specification tables and about 25 pages of operating photographs make up the catalog.

Power Shovels.—GENERAL EXCAVATOR CO., Marion, Ohio, has issued a bulletin describing its ½ yard gasoline power shovel. Complete descriptions are given of all of the mechanical details of the machine together with dimensional drawings and photographs of it.

Heaters.—HAUCK MFG. CO., 126 Kent St., Brooklyn, N. Y., has made available a number of new pamphlets describing its various types of heaters. These include concrete heaters, thawing torches, kerosene burners for asphalt melting, lead melting furnaces and torches for melting lead from pipe joints.

Tractors.—LINN MFG. CORP., Morris, N. Y., has recently issued a 32-page booklet describing and illustrating its tractor which is in reality a motor truck with the rear wheels replaced by crawler units. Beside the descriptions and specifications, photographs are given of the tractors in use on various types of construction and haulage work. Some of the illustrations show the front wheels replaced by runners for use in winter hauling.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

Business Side of Construction

Facts and Events that Affect Cost and Volume

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
June 16, 1927	$17,537,000	$31,635,000	$49,172,000
June 9, 1927	30,198,000	38,374,000	68,572,000
June 7, 1926	27,252,000	27,667,000	54,919,000
Heaviest Week			
1927, June 2	58,464,000	27,629,000	86,093,000
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
Jan. 1 to Date			
1927	540,525,000	825,863,000	1,366,388,000
1926	492,062,000	826,808,000	1,318,870,000

On June 1, 1927

E. N.-R. Construction Cost Index Number	205.55
E. N.-R. Construction Volume Index Number	299

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Water-works Demand Closely Parallels That of 1926

Situation Measured By Ratio of Proposed Projects to Actual Contracts Awarded

THE ratio of work contemplated to work actually placed under contract offers a gage of future demand. This applies both to number of jobs contemplated and awarded and to the value of such jobs. Number of projects indicate the range of opportunities for contractors and manufacturers of equipment and materials. Money value indicates the amount of demand for machinery, equipment and materials. The two sets of statistics can of course be brought together to measure the average project. All these figures—number and value and ratio of contemplated work to contracts—have been compiled for the water-works field, from *Engineering News-Record's* statistics of jobs of $15,000 and more.

The ratios showing preponderance (or otherwise) of number or value of early projects over those under contract are obtained by merely dividing proposed work by the contracts.

These factors are important as showing the amount of proposed work yet to be placed under contract. For example, in New England in 1926, the value of water-works improvements that was contemplated amounted to 4.8 times as much money as did the value of the awards during that year. This means that there is a great deal of this class of work in prospect for New England. The two tables merit careful study.

Study of the figures will indicate that conditions in the water-works field are generally favorable. This is especially true with respect to New England, the South, and throughout the West. The only important falling off is in the Middle Atlantic States, where the volume of new work coming along is well under the 1926 rate. Water-works projects in the two periods average as follows:

Proposed 1926	$120,000
Contracts 1926	94,000
Proposed 1927 (4 mos.)	199,000
Contracts 1927 (4 mos.)	104,000

TABLE I—VALUE OF WATER-WORKS PROJECTS, PROPOSED AND AWARDED AND RATIO OF FORMER TO LATTER IN 1926 AND FIRST FOUL MONTHS OF 1927

	Proposed 1926	Contracts 1926	Ratio Proposed to Contracts 1926
New England	$24,487,000	$5,098,000	4.80
Middle Atlantic	11,182,000	8,730,000	1.28
South	11,894,000	5,605,000	2.84
Middle West	23,932,000	18,662,000	1.28
West of Mississippi	37,848,000	15,395,000	2.46
Far West	26,281,000	8,157,000	2.23
United States	$139,624,000	$61,647,000	2.29

	Proposed 4 mos. 1927	Contracts 4 mos. 1927	Ratio Proposed to Contracts 4 mos. 1927
New England	$1,629,000	$701,000	2.32
Middle Atlantic	1,273,000	2,560,000	.47
South	6,775,000	2,485,000	2.74
Middle West	37,994,000*	6,679,000	5.70
West of Mississippi	8,471,000	3,551,000	2.39
Far West	12,850,000	4,229,000	3.04
United States	$68,992,000	$20,205,000	3.42

*Includes a February item of $35,629,000 for pumping Lake Michigan water to towns within 38 mi. of Chicago, by Greater Chicago Lake Water Co.

TABLE II—NUMBER OF WATER-WORKS PROJECTS, PROPOSED AND AWARDED AND RATIO OF FORMER TO LATTER IN 1926 AND FIRST FOUR MONTHS OF 1927

	Proposed 1926	Contracts 1926	Ratio Proposed to Contracts 1926	Proposed 4 mos. 1927	Contracts 4 mos. 1927	Ratio Proposed to Contracts 4 mos. 1927
N. E.	52	46	1.13	19	15	1.27
M. A.	62	131	.47	17	35	.49
South	153	47	3.26	45	13	3.47
Mid. West	179	207	.87	50	47	1.06
West of Miss.	535	172	3.11	163	58	2.81
Far West	182	57	3.19	53	27	1.96
U. S.	1,163	660	1.76	347	195	1.78

Brick Imports Show Heavy Gain

Foreign Material Equal to 12 Per Cent of Shipments from Domestic Yards in N. Y. District

THAT there has been no let-up in the steady flow of brick importations is shown by the following comparison of receipts for the Port of New York during the first quarter this year, with those of the corresponding period in 1926.

While brick imports gained 43 per cent in number during the period under discussion, the increase in value was a trifle over one per cent.

The money values mentioned in the table represent prices of brick in the foreign markets, before loading for shipment. Although the increase in number, as shown in the table, amounted to 43 per cent, the total of those brought in during the first quarter this year, is only 12 per cent of the quantity shipped in the same length of time, from domestic yards in the district comprising New York, New Jersey, Maryland, District of Columbia, Delaware and Pennsylvania.

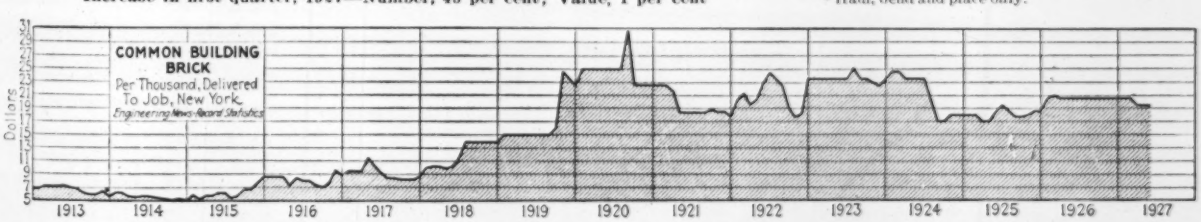
Brick imports did not assume serious proportions until 1924, at which time Belgium, as at present, was the chief source of supply.

The number of bricks used in New York City construction during the entire year 1926 reached a total of 1,314,000,000. This material came from New York (up-state), New Jersey, Staten Island, Connecticut, Massachusetts, Virginia, Belgium and Holland. Germany dropped out of the brick exporting field over a year ago. Figures in this table include sand-lime and other varieties as well as the building units of burned clay.

IMPORTATIONS OF DUTY-FREE BRICK INTO THE PORT OF NEW YORK

Month	Country of Origin	1927 Number	1927 Value	1926 Number	1926 Value
January	Belgium	4,331,000	$22,927	1,725,000	$16,644
	Netherlands	.....	.....	4,734,000	44,218
February	Belgium	7,385,000	53,460	3,218,000	17,911
	Netherlands	.....	.....	261,000	2,932
March	Belgium	6,137,000	26,854	1,809,000	9,442
	Netherlands	2,300,000	13,116	2,351,000	23,760
	Norway	1,000	10	.....	.....
	Italy	.....	.....	1,000	13
Total first quarter		20,154,000	$116,367	14,099,000	$114,920

Increase in first quarter, 1927—Number, 43 per cent; Value, 1 per cent



PRICE OF BRICK DELIVERED AT JOB, BY MONTHS, 1913-1927

Special Tabulation of Unit Prices

Reinforcing Steel

The following unit prices (materials in place) are included in the low bidders' estimates on water-works jobs:

Location	Date	Lb.	Price per Lb.
Tulsa, Okla	Sept., 1922	481,600	$0.045
Memphis, Tenn	Oct., 1922	1,200,000	.036
Poughkeepsie, N. Y.	Apr., 1923	1,200	.10
Mariemont, O.	Apr., 1923	1,000	.10
Cleveland, O.	May, 1923	2,812,000	.05
Cleveland, O.	June, 1923	500	.10
Cleveland, O.	July, 1923	7,900	.10
Springfield, Ill.	Sept., 1923	30,500	.05
Portland, Ore.	Oct., 1923	4,000	.0872
New Bedford, Mass.	Oct., 1923	23,000	.109
Fairmont, W. Va.	Feb., 1924	205,000	.0525
Kansas City, Mo.	Mar., 1924	100,000	.05
Albany, N. Y.	Apr., 1924	385,000	.043
Springfield, Mass.	May, 1924	200,000	.06
Providence, R. I.	May, 1924	900,000	.06
Denver, Colo.	June, 1924	150,000	.06
Denver, Colo.	June, 1924	1,510,000	.07
Kent, O.	June, 1924	190,000	.0487
Staunton, Va.	Aug., 1924	40,000	.08
Kansas City, Mo.	Mar., 1925	60,000	.06
Ashland, Pa.	Apr., 1925	36,000	.08
Hartford, Conn.	Sept., 1926	90,500	.07
Allentown, Pa.	Apr., 1927	98,500	.0425

The following unit prices (materials in place) are from paving projects:

Location	Date	Lb.	Price per Lb.
Maine St. Hy.	Aug., 1922	343,400	$0.0425*
Ky. St. Hy.	Aug., 1922	50,069	.04*
Tex. St. Hy.	Aug., 1922	127,989	.055
Ky. St. Hy.	Aug., 1922	119,037	.07
Utah St. Hy.	Sept., 1922	22,000	.02*
Ariz. St. Hy.	Aug., 1922	4,050	.02*
Summer Co., Kans.	Sept., 1922	7,450	.08
Mo. St. Hy.	Sept., 1922	22,509	.05
Vt. St. Hy.	Sept., 1922	6,871	.05
Wash. St. Hy.	Oct., 1922	55,510	.08
Brownsville, Tex.	Oct., 1922	294,605	.05
Utah St. Hy.	Oct., 1922	11,800	.02*
Tenn. St. Hy.	Oct., 1922	52,569	.06
Mont. St. Hy.	Oct., 1922	3,600	.10
Ky. St. Hy.	Jan., 1923	113,090	.06
Ore. St. Hy.	Feb., 1923	47,000	.12
Liberty, Tex.	Feb., 1923	687,769	.045*
Baltimore, Md.	Apr., 1923	2,272	.10
Del. St. Hy.	Apr., 1923	12,500	.08
Ky. St. Hy.	Apr., 1923	97,469	.06
Del. St. Hy.	June, 1923	13,000	.10
Yavapai Co., Ariz.	July, 1923	194,000	.063
Detroit, Mich.	July, 1923	92,400	.045*
Del. St. Hy.	July, 1923	4,200	.10
Ky. St. Hy.	Sept., 1923	70,421	.08
Va. St. Hy.	Nov., 1923	35,724	.08
Idaho St. Hy.	Nov., 1923	18,598	.08
Ky. St. Hy.	Jan., 1924	78,820	.06
N. H. St. Hy.	Feb., 1924	554	.07
Calif. St. Hy.	June, 1924	84,500	.055
Calif. St. Hy.	June, 1924	14,000	.06
Idaho St. Hy.	Apr., 1925	26,444	.09
Topeka, Kans.	May, 1925	16,670	.05
Wanaque, N. J.	Sept., 1925	2,000	.0425*
Idaho St. Hy.	Mar., 1926	18,163	.08
Chicago, Ill.	Mar., 1926	935,000	.0425*
Kans. St. Hy.	July, 1926	57,722	.05
Wash. St. Hy.	Sept., 1926	5,000	.06
Gulfport, Miss.	Nov., 1926	12,600	.05
Fla. St. Hy.	Nov., 1926	80,142	.08
Ariz. St. Hy.	Nov., 1926	45,225	.04*
Ore. St. Hy.	Dec., 1926	22,000	.07
Bur. Pub. Rds., Calif.	Dec., 1926	3,536	.06
Polk Co., Fla.	Dec., 1926	72,420	.07
Va. St. Hy.	Dec., 1926	7,537	.05
Boston, Mass.	Dec., 1926	307,400	.025*
N. M. St. Hy.	Dec., 1926	40,318	.08
Boston, Mass.	Dec., 1926	199,700	.0375*
N. M. St. Hy.	Dec., 1926	4,765	.07
Fla. St. Hy.	Jan., 1927	106,125	.06
Ida. St. Hy.	Jan., 1927	3,500	.08
Ariz. St. Hy.	Jan., 1927	16,014	.02*
Va. St. Hy.	Jan., 1927	39,942	.06
Ky. St. Hy.	Jan., 1927	259,290	.06
Kan. St. Hy.	Jan., 1927	48,981	.055
Va. St. Hy.	Jan., 1927	14,288	.07
Mo. St. Hy.	Jan., 1927	53,520	.05
Va. St. Hy.	Jan., 1927	5,978	.05
Chicago, Ill.	Feb., 1927	425,000	.0475*
Calif. St. Hy.	Feb., 1927	82,000	.04*
Houston, Tex.	Feb., 1927	150,000	.06

* Haul, bend and place only.

Weekly Construction Market

THE present recession in output of the principal construction materials is slightly more than seasonal, according to latest production reports from various industries throughout the country.

Portland cement forms the chief exception in that production and shipments in this material are at present following the regular upward movement, characteristic of this time of the year.

Construction demand, as measured by contracts awarded, is nearly 4 per cent ahead of 1926, taking the cumulative money value, Jan. 1 to date. Cost of construction (labor plus materials) is less than one per cent above a year ago and tending slightly downward, viewing the situation nationally.

Cement mill stocks show the usual tendency to subside as summer approaches; prices, however, remain steady in nearly every direction.

Steel buying has failed to show improvement during the last month, judging from unfilled orders on books of the U. S. Steel Corporation at the end of May. Shipments of this material have also declined perceptibly. Steel ingot output reached a record level in 1926. The first five months of this year, however, netted a smaller, tonnage, all companies taken together, than that realized during the corresponding period last year. The seasonal drop from April to May of this year, was smaller than that for the same month in 1926.

Pig iron, the starting point of price movements in finished steel, is experiencing slowness of demand, with buying confined to small lots. The principal hot-rolled steel materials are apparently weaker than a month ago. Bars, shapes and plates, base, Pittsburgh, continue under the quotation of $1.90 per 100 lb.; as low as $1.70, however, is reported on shapes and $1.75 for plates.

Brick buying, at yards throughout the country, is slower than a month ago. Reserve stocks, regardless of imports, are sufficiently reduced to keep prices from declining to any great extent.

The lumber movement, for the principal mills of the country, reflects the seasonal restriction which reaches its culmination in the July 4 shut-down, observed each year in the timber regions.

Some of the logging camps in the Pacific Northwest contemplate a lay-off lasting from two to four weeks. This should stiffen prices, provided no further slump in buying occurs.

Hardwood production appears in greater volume but this is comparing the situation with the retarded operations recently caused by Mississippi floods.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.00	$3.00	$3.80
Structural rivets, 100 lb.	5.00	3.80	4.75	3.50	3.75	4.65	5.00	5.00	7.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	2.75	2.30@2.50	2.87½	—3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	48%	41%	42@53.8%	48%	37.83
Cast-iron pipe, 6 in. and over, ton	47.60	—40.75	54.00	44.20	48.50	56.50	—46.00	55.00	62.50
Concreting Material									
Cement without bags, bbl.	2.35@2.50	+2.40	2.05	2.05	2.22	2.85	2.51	2.65	1.36
Gravel, ¾ in., cu.yd.	1.75	+2.20	2.38	1.70	1.65	1.90	1.80	1.25	1.90
Sand, cu.yd.	1.00	—1.40	2.00	1.65	1.25	1.00	1.40	1.25	1.35
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59@61	34.00	56.00	40.50	39.25	34.25	27.00	23.00	50.00
Lime, finishing, hydrated, ton	18.20	+24.50	19.00	20.00	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	1.50	1.82	1.50	1.70	2.70	1.70	2.80	10.00
Common brick, delivered, 1,000...	19@20	+12.50	14.10	12.00	13.75	9@10	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block.	Not used	—.0724	.112	.076	.072	.085	.....	.10	.10
Hollow partition tile 4x12x12, per block.	.1027	.0724	.112	.076	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	89¼	+94½	1.10	.90	.99	1.10	.95	.95	1.05
Common Labor									
Common labor, union, hour	.90⅜	.30		.90	.....	.....	.60	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.....	.45@.60	.31¼@.50	.50	.62½	.30@.35

Explanation of Prices— Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list prices is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel), shapes and rivets delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅜c.

Chicago quotes hydrated lime in 50 lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b. Fir is quoted instead of pine. Reinforcing bars (billet steel) and rivets f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) and rivets at warehouse in carload lots; shapes, less-than-carload lots. Steel pipe under 3-in., 51% off list.

THIS limited price list is published weekly except in the first issue of each month and gives current prices on the principal construction materials in the chief cities.

The first issue of each month carries complete quotations for all of the basic materials and for the rest of the important cities, also wage rates for the principal building trades and common labor. The last complete list will be found in the issue of June 2, the next on July 1.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in the Construction News and Unit Prices sections following.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) rivets and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) and rivets, f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) carlots; shapes and rivets, less-than-carload lots.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes and rivets; less-than-carload lots.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) carlots; shapes and rivets, l.c.l.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.96). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shopment. Steel pipe per 100 ft. net: 2½ in., $37.83. Bars (billet steel) and shapes, in carload lots; rivets, l.c.l.

UNIT PRICES For actual prices bid on materials in place at various construction jobs throughout the country see pp. 84-86 of this issue, following Construction News.